Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

MAY, 1950

TECHNOLOGY DEPT.
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The WEAN ENGINEERING COMPANY INC.
WARREN, OHIO

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MAY 24 1950
DETROIT

To better serve the requirements of the trade and to operate at a profit in a highly competitive field, steel plant executives recognize they must have the most modern and efficient equipment available.

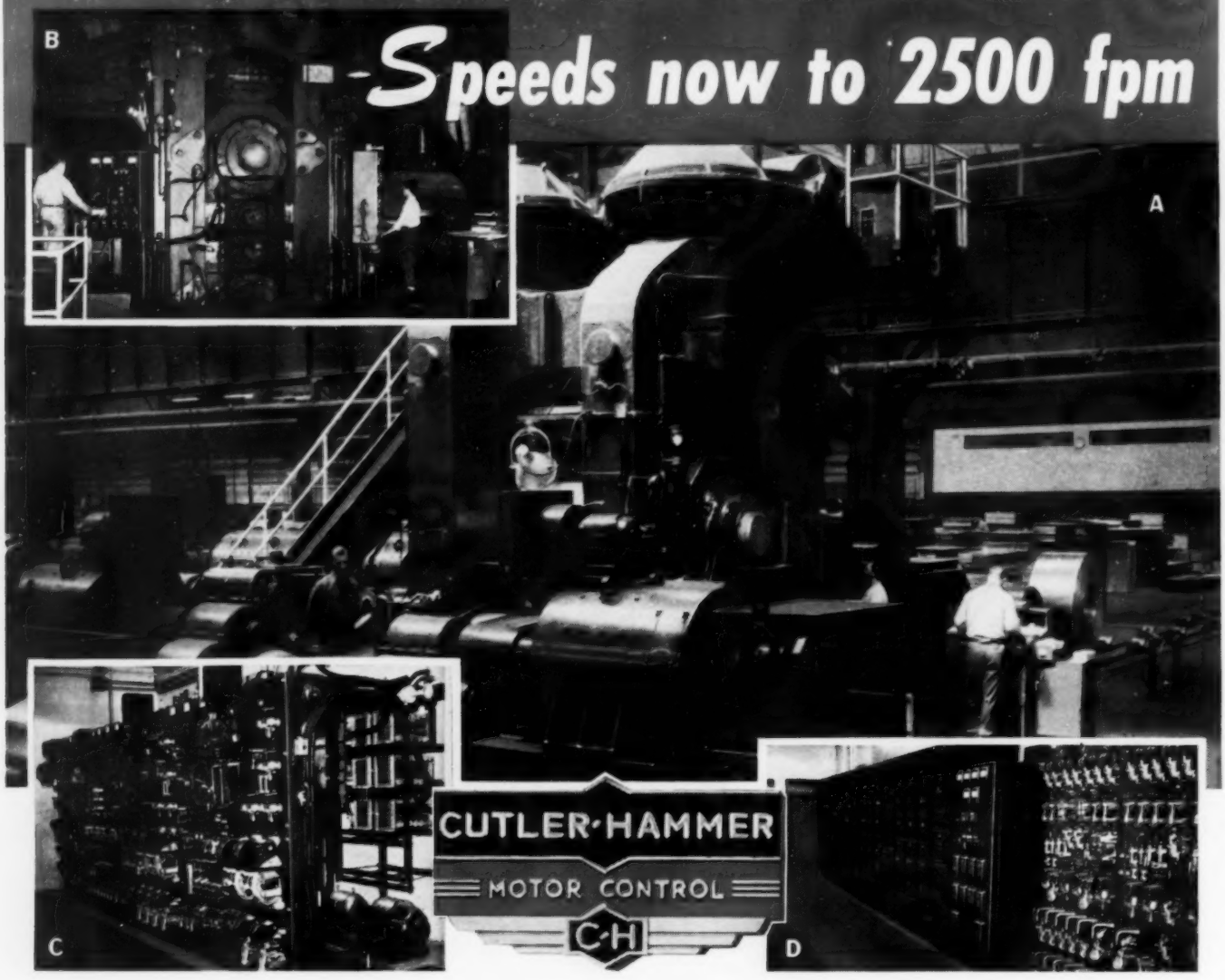
The Wean Engineering Company, Inc., Warren, Ohio, is the recognized leader in the design and installation of sheet, tin and strip mill equipment, whether it be one piece or a complete unit.

Many steel mill executives, both in this country and abroad, have recognized the advantages and efficiency of WEAN SHEET, STRIP AND TIN MILL EQUIPMENT. The same recognized advantages are available for overcoming your problems.

SPECIALISTS IN SHEET, TIN and STRIP MILL EQUIPMENT

Carnegie-Illinois Temper Pass Mill REBUILT

-Speeds now to 2500 fpm



Behind this achievement is the engineering know how of Cutler-Hammer, Inc. and Elliott Co.

Part of a modernization program instituted at the Carnegie-Illinois Irvin Works was the complete rebuilding of the No. 3 sheet temper pass mill. This now-modern mill processes coils of steel sheet up to 50 inches in width, 72 inches in diameter, and 50,000 lbs. in weight, at a speed range of 250 to 2500 feet per minute, with 3750 fpm a possibility in the future. Control of this mill is such that the operator can maintain tension at any degree—the requirement most vital to uniform sheet texture and quality—during "stall", acceleration, normal operation at any selected speed and especially during deceleration. Cutler-Hammer furnished the control engineering behind this outstanding achievement . . . as has been so often the case in events that have written steel mill history . . . CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

Ⓐ 2500 fpm is the speed of the strip passing through this new mill.

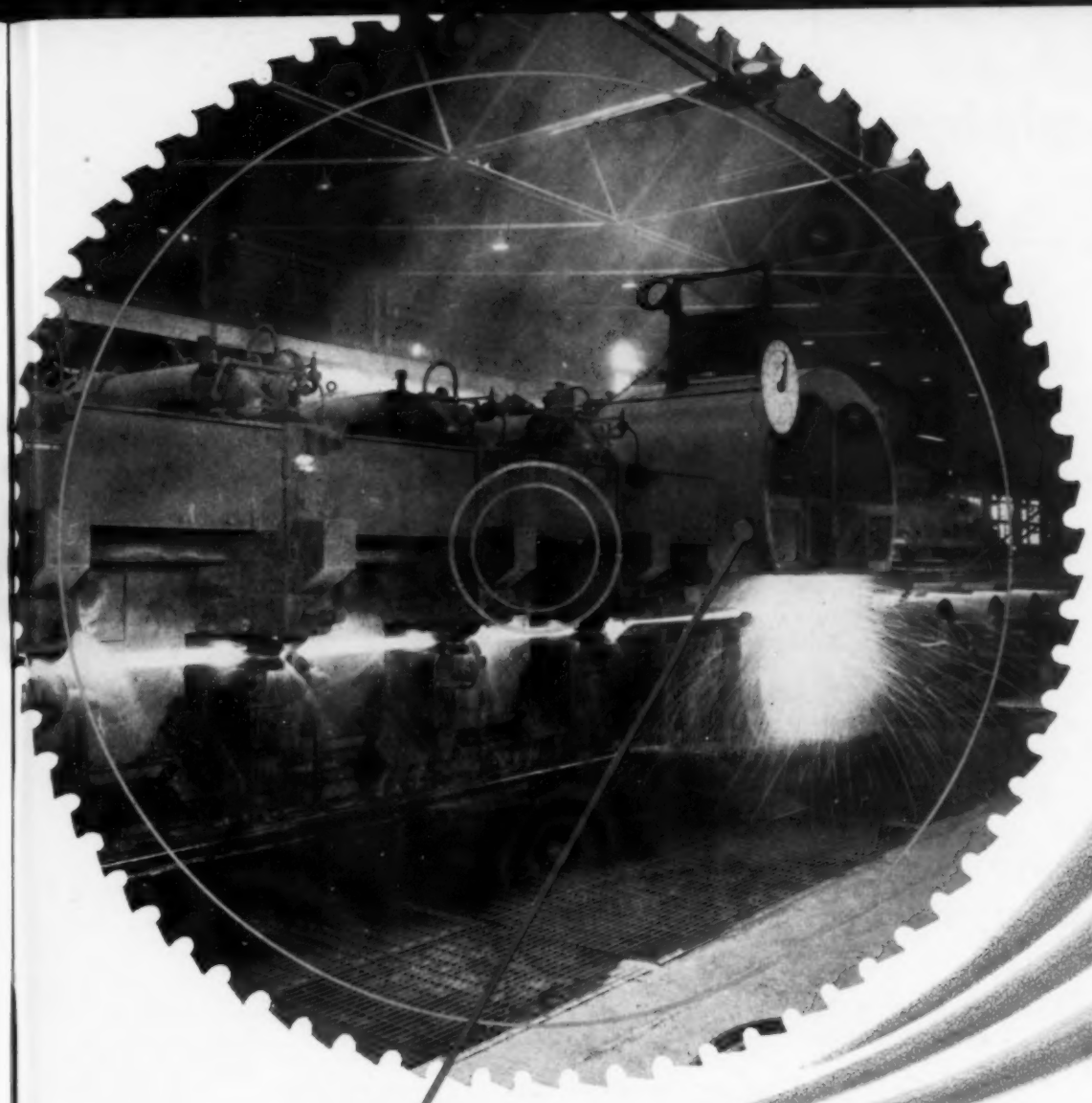
Ⓑ Two Cutler-Hammer Control stands provide these operators with control of all operations of the mill.

Ⓒ Cutler-Hammer Control Panel for D.C. Main Mill Drive.

Ⓓ Cutler-Hammer D.C. Auxiliary Control and A.C. Unitrol cubicles.

Features of the New Temper Pass Mill Drive

All operations performed from operator's cabinet at each end of mill. Threading strip through mill done in minimum time. Strip tension between mill and reels then regulated to desired degree by means of VSA current regulating exciters. By proper adjustment of compensation for IR drop, friction, windage, and strip speed, tension may be held constant or tapered as required for uniform quality of processed strip. Change in reel motor current and thus tension, is translated to VSA regulators which immediately modify reel motor fields to re-establish the tension. Sudden transient requirements of wider current modification are also translated to VSA voltage regulators. Reel generators immediately respond to help re-establish desired current. Required change in current and torque when accelerating and decelerating is measured by a WR^2 compensating device which responds to rate of change in mill speed and thus insures proper compensation with any rate of acceleration.



new HOT SAW cuts pipe 1,000 feet per minute

• **Aetna-Standard does it again!** The world's leading pipe mill designers and builders develop another idea to increase production in continuous butt weld pipe mills — A new Hot Saw that will cut off small diameter pipe at the rate of 1,000 feet per minute!

The new Aetna-Standard Hot Saw can operate at just twice the speed of hot saws now in use. And it cuts to allowable tolerances, too.

With the new Hot Saw, you can increase your production substantially.

Here's a sure way to reduce operating cost. Get the full story on the new Hot Saw from Aetna-Standard today.

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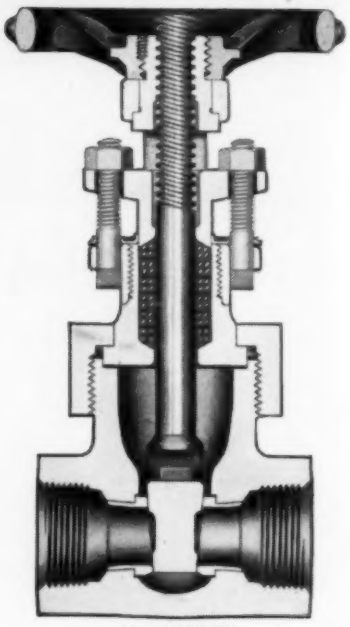
YOUNGSTOWN, OHIO
ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND
AETNA-STANDARD ENGINEERING COMPANY, LTD., TORONTO, ONTARIO, CANADA

All the piping equipment you need ...on one order to CRANE



No. 3602XW

For steam up to 850 deg. F., and for water, gas, or air.
Sizes: ¼ to 2 in.
Screwed or welding ends

SMALL STEEL VALVES WITH BIG VALVE FEATURES

Crane 600-Pound Small Steel Gates with Union Bonnet—for steam, water, gas, or air—are smaller, lighter, and more compact than usual high pressure design . . . yet are amply strong. Metal sections at all points provide extra strength and safety under rough usage and extreme pressure-temperature conditions.

Body, bonnet and yoke are high quality carbon steel. Seating is Hardened Stainless to Exelloy, offering superior resistance to wear, corrosion, and temperature effects. Husky bonnet ring with long, precision-cut threads pulls up easily . . . always stays tight. Long-lived blowout-proof gasket in bonnet joint is unaffected by highest temperatures or fluids on recommended services. For more information, **write for circular AD-1741.**

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Branches and Wholesalers Serving All Industrial Areas

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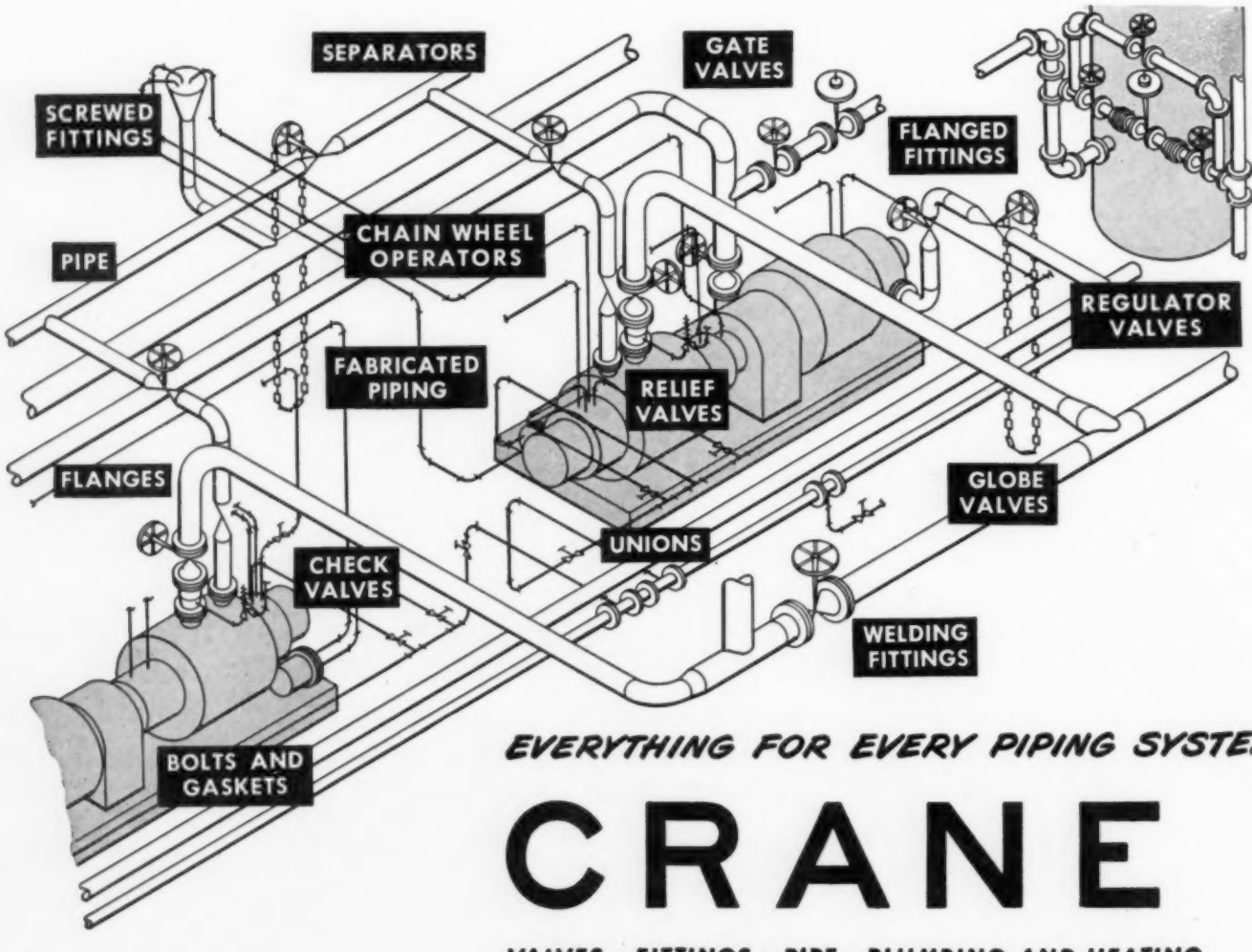

EVERYTHING FOR EVERY PIPING SYSTEM

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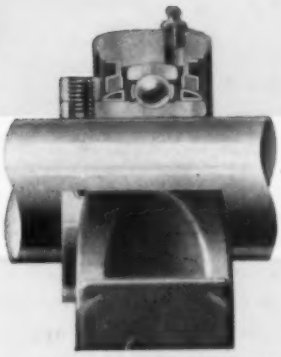
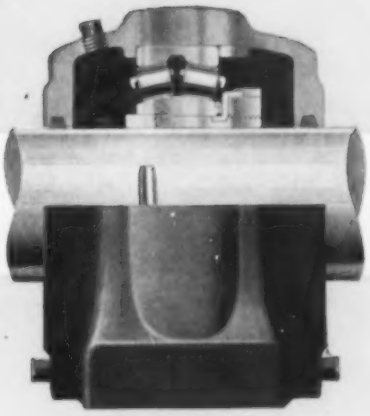
VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

Lock a LINK-BELT Ball or Roller Bearing to your shaft



BALL BEARING—SERIES 200



ROLLER BEARING—SERIES 6800

without distortion

because . . . the set screws are not threaded into the inner ring of the bearing. The spring-locking collar, or the tapered sleeve, clamps the bearing to the shaft.

with firm grip

because . . . of the "hoop tension" of the spring-locking collar, or the tight grip of the tapered sleeve.

without mislocation

because . . . the spring-locking collar is factory assembled and permanently located in correct position on the bearing.

regardless of rotation

because . . . of symmetrical locking. Two simple operations securely lock a LINK-BELT bearing. Simply slip on shaft; then tighten two set screws, or pull up the locknut.

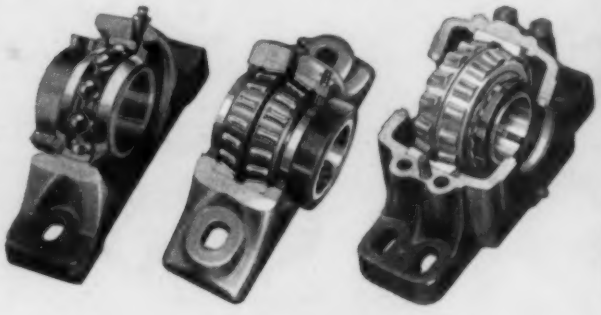
with wide distribution of bearing load

because . . . the wide inner ring of the bearing, or the tapered sleeve, provides a large area of shaft contact.

May we send you the new Link-Belt Ball and Roller Bearing Catalog No. 2550, containing complete data useful in design and replacement? Link-Belt engineers are quickly available to discuss your bearing problems. Contact the nearest office.

LINK-BELT COMPANY Indianapolis 6, Chicago 9, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and Distributors in Principal Cities. 11,700

A complete line of bearings is available from stock, throughout the country, in pillow blocks, cartridge, flanged cartridge, flanged, hanger and takeup blocks —also unmounted bearings.

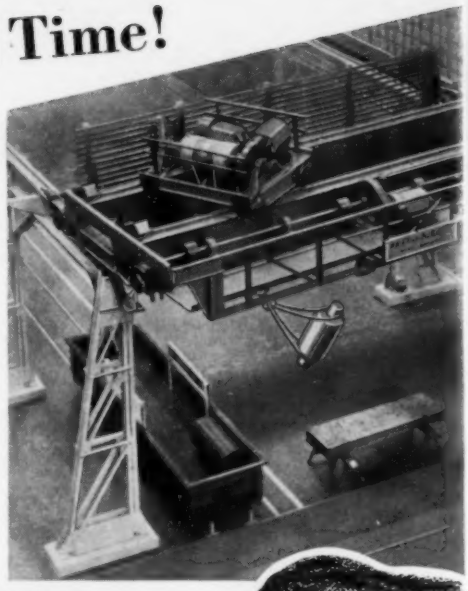


LINK-BELT

BALL & ROLLER

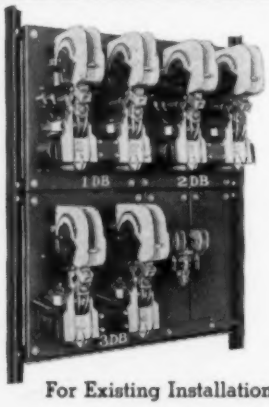
BEARINGS

Couldn't Reach the Foot Brake in Time!

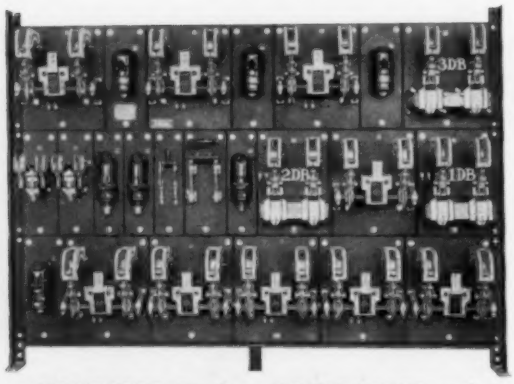


Operators, intent on maintaining a high rate of production, depend almost entirely on the reverse-power (plugging) method of control for a quick stop, using the foot brake for parking the crane or holding it against drift. BUT, at the instant of plugging, *should power fail* or the *overload relays trip*, the operator throws the master handle to reverse. Nothing happens . . . he moves the handle back and forth . . . there is still no response . . . he realizes power has failed. His foot reaches for the brake pedal —*but too late*—too late to avoid a collision with another crane on the same runway . . . to avoid crashing into or going over the end bumpers.

STOP Hi-Speed Cranes with the Same Motors that Drive Them



For Existing Installations



COMPLETE Duplex CONTROLLER with EC&M Dynamic Braking Bridge Stop Control including Automatic Deceleration Feature.

Now these dangers can be eliminated by the addition of simple equipment. Upon power failure, the EC&M *Dynamic Braking* Bridge Stop Control *automatically* converts the motors into self-excited generators to provide retardation quickly. No additional collector bars are required—no outside source of power.

This control is equally advantageous for larry or transfer cars—for man trolleys of ore and coal bridges, charging machines, soaking pit cranes, etc. On icy, slippery rails, wheels do not slide to a stop—instead, this system releases and re-applies retardation to give a quicker stop than when the wheels remain locked.

Dynamic braking is fast—equally effective in either direction—EC&M's deceleration feature *maintains* better braking throughout the entire stopping period. Bulletin 921-6.0 gives complete facts. Write for a copy.

EMERGENCY APPLIED { On Power Failure / When Overload Relays Trip

SELECTIVELY APPLIED { By the Operator / By End-zone Limit Switches

THE ELECTRIC CONTROLLER & MFG. CO.
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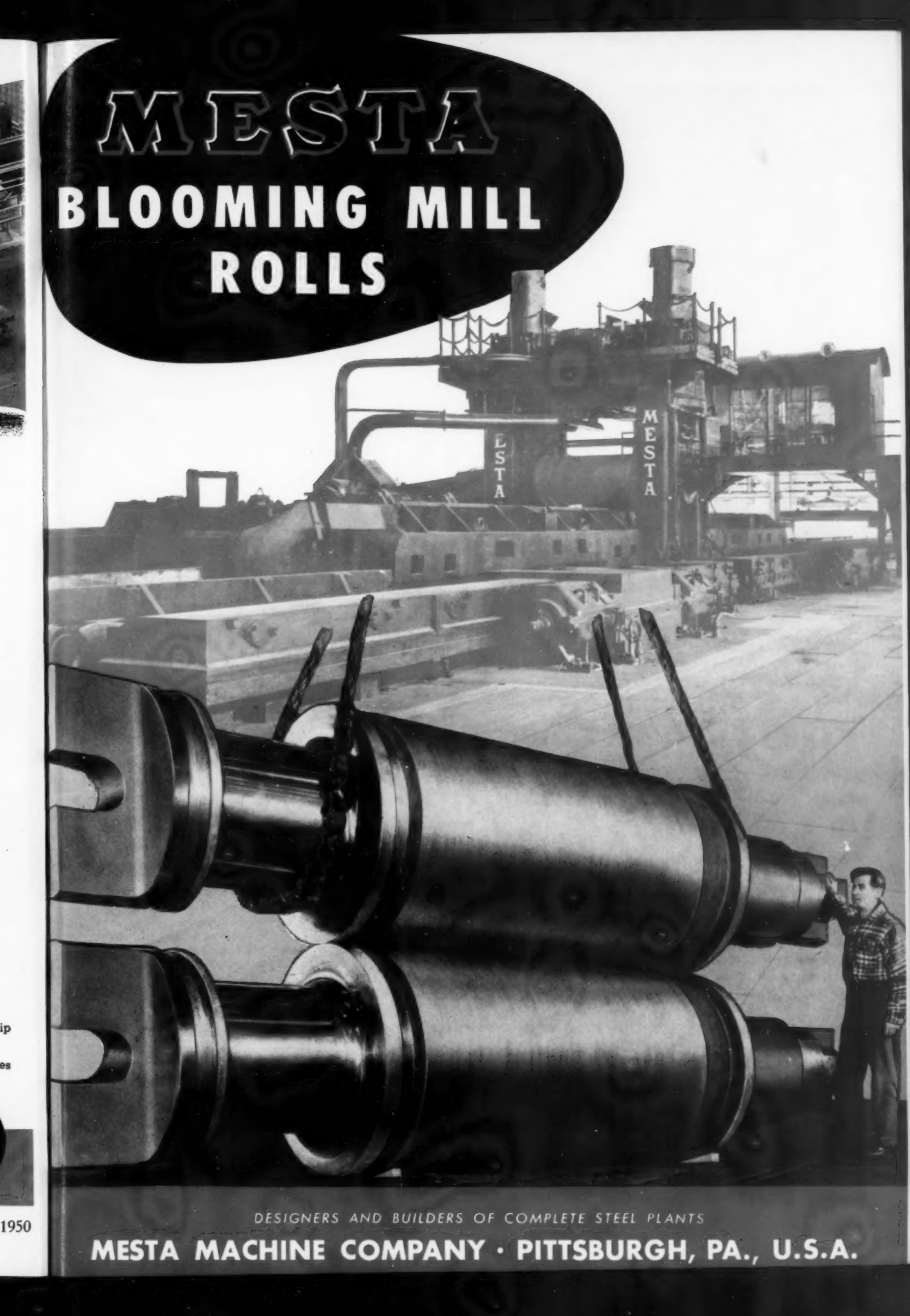
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BLOOMING MILL
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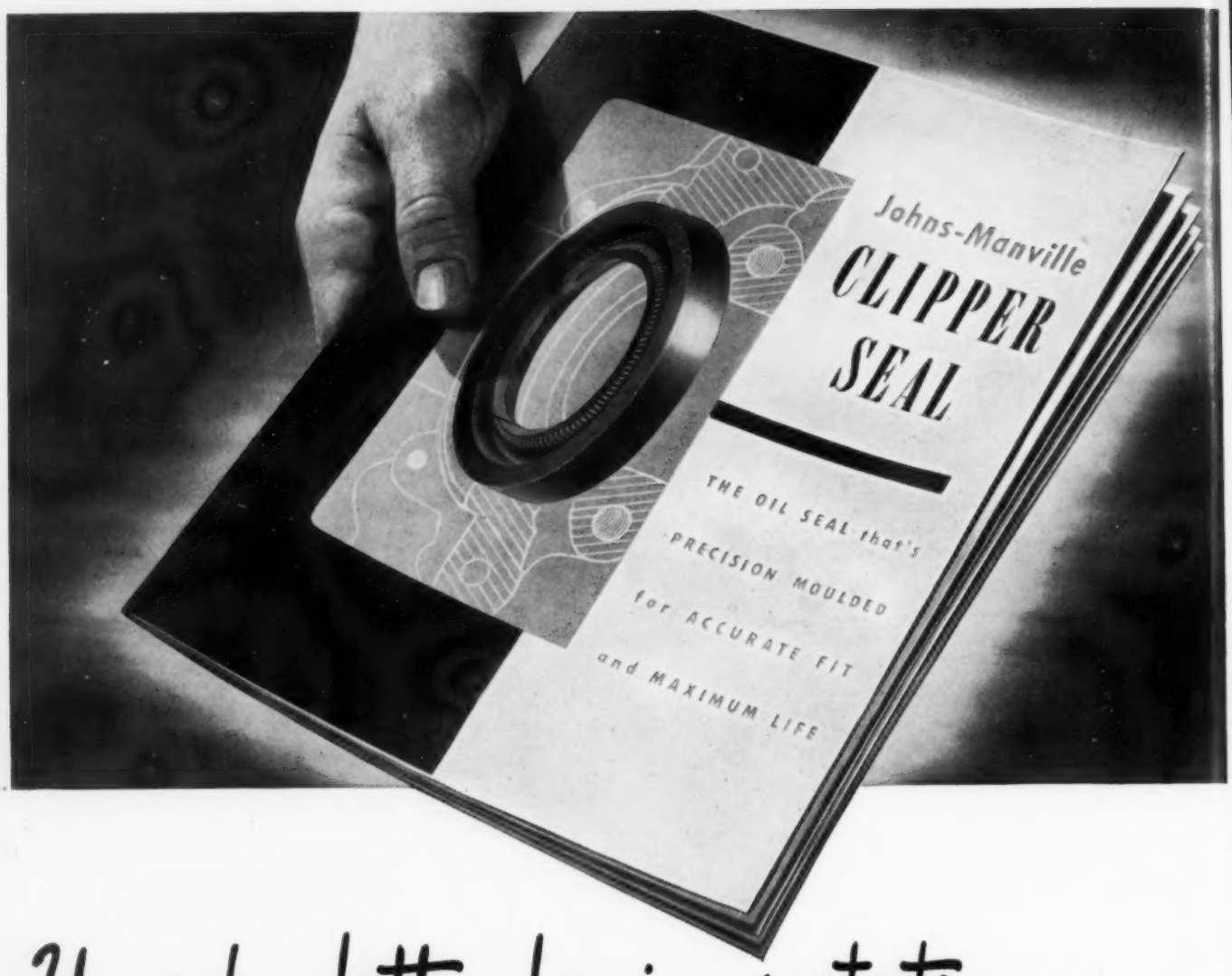
DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS
MESTA MACHINE COMPANY · PITTSBURGH, PA., U.S.A.



Yours for better bearing protection

—this new book about OIL SEALS

Here is a book filled with useful data about oil seals that you're sure to want for your files. It gives the complete story of the Johns-Manville Clipper Seal . . . tells how this precision oil seal with the one-piece moulded body is providing better bearing protection at lower cost in many types of applications.

Here you will find photographs and diagrams of typical Clipper Seal installations; information on the various lip designs that provide a choice of bearing surfaces; the wide range of sizes that are available; the thick or thin flanges designed for the precision sealing in many bearing housings.

Here are Clipper Seals that help cut maintenance costs and down time . . . seals that are designed specially for quick, easy application where space is limited . . . for resistance to corrosive attack . . . for high temperature operation and other special conditions.

Whether you are concerned with the design or maintenance of equipment, this new Clipper Seal book can help you get better bearing protection at lower cost. Send for your copy today.

JUST FILL IN THE COUPON BELOW

JM PRODUCTS

Johns-Manville

CLIPPER SEALS

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Please send me the new Clipper Seal Book (PK-46A).

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Wellman will build it

Special Cranes
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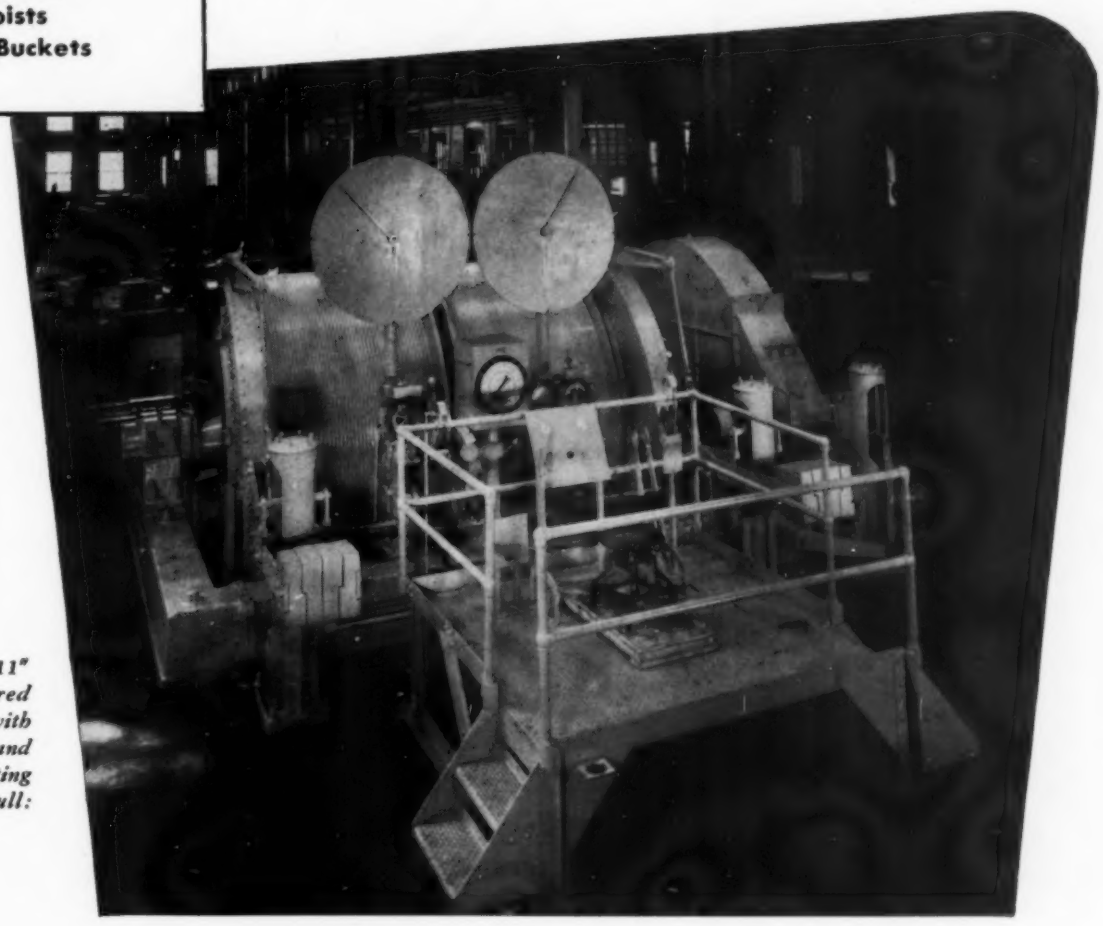
Wellman Electric Mine Hoists

Proved by performance



Wellman 10' x 4' 11" Double Drum Geared Electric Mine Hoist with 7' axial plate clutch and 10' x 13' Parallel Acting Brakes. Rated rope pull: 22,000 lbs.

● For more than half a century, in mines all over the world, Wellman Electric Mine Hoists have been used because they combine expert design with expert construction . . . featuring all the "modern improvements" developed in our 50 years' experience. Wellman Mine Hoists provide maximum safety, peak economy, and trouble-free operation under a wide variety of conditions. Let us give you recommendations for hoists that will do your job most satisfactorily.

THE WELLMAN ENGINEERING COMPANY

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*UNIFORMITY

Under all conditions the proved performance of Tycol lubricants more than meets their recommended service.

Rigidly controlled and tested during manufacture . . . and refined from the highest grade crudes, Tycol oils and greases are known for their *UNIFORMITY within each classification — from the first drum to the last.

This unvarying high quality, plus the scope of the line, accounts for Tycol's wide acceptance by industry interested in maximum production . . . top efficiency . . . lowest operating cost.

Whatever your lubrication need, let a Tide Water Associated engineer help you select the one suited for your particular need. Call, write or wire your nearest Tide Water Associated office for full details.

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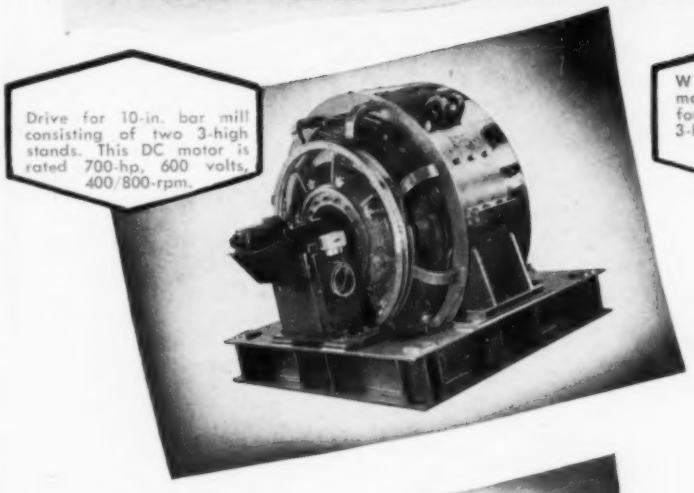
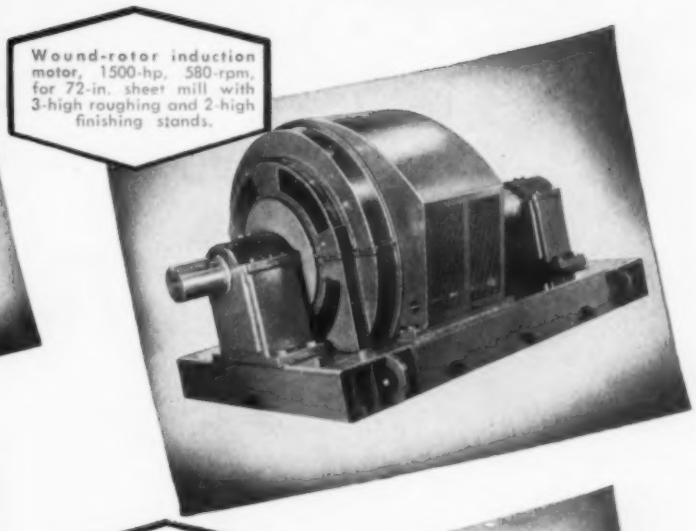
*LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA"
This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL — THE WORLD'S MOST FAMOUS MOTOR OIL

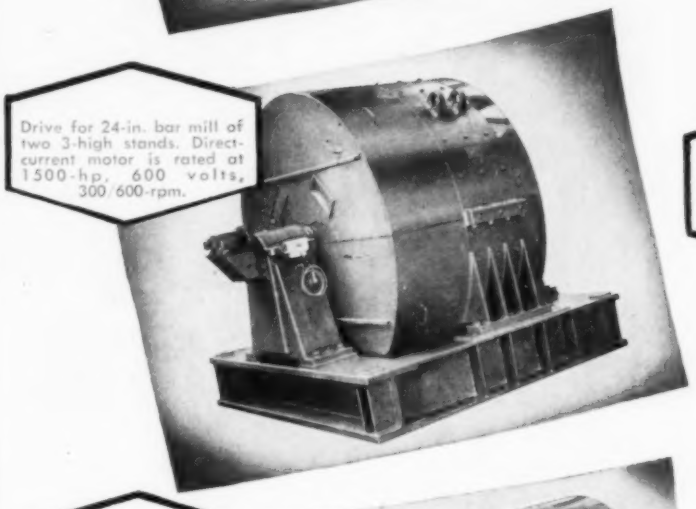
Large Midwest mill selects Elliott FABRI-STEEL ELECTRICAL EQUIPMENT



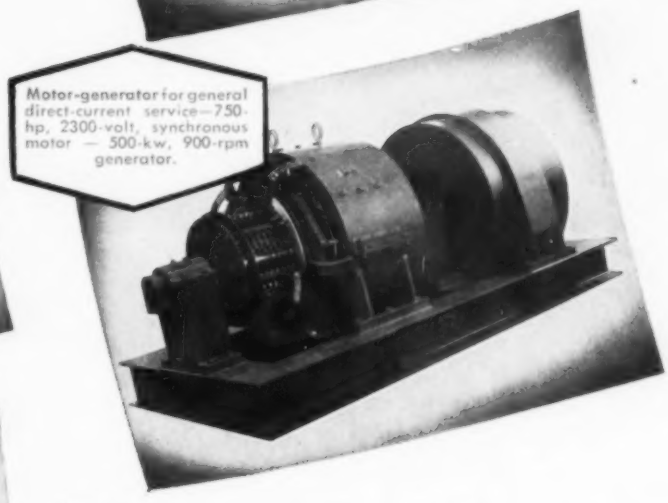
Drive for 10-in. bar mill consisting of two 3-high stands. This DC motor is rated 700-hp, 600 volts, 400/800-rpm.



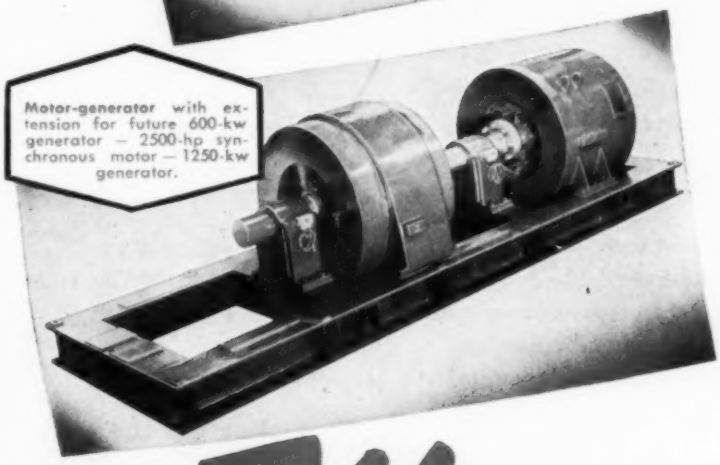
Wound-rotor induction motor, 1500-hp, 580-rpm, for 72-in. sheet mill with 3-high roughing and 2-high finishing stands.



Drive for 24-in. bar mill of two 3-high stands. Direct-current motor is rated at 1500-hp, 600 volts, 300/600-rpm.



Motor-generator for general direct-current service—750-hp, 2300-volt, synchronous motor — 500-kw, 900-rpm generator.



Motor-generator with extension for future 600-kw generator — 2500-hp synchronous motor — 1250-kw generator.

The Elliott equipment furnished to this mill illustrates the wide range of types and sizes of motors and generators that Elliott Company is building for the steel industry. Elliott Company has been building large machines, of both direct-current and alternating-current designs, for 50 years.

MR-1A

Elliott

COMPANY

Department 15

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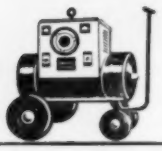
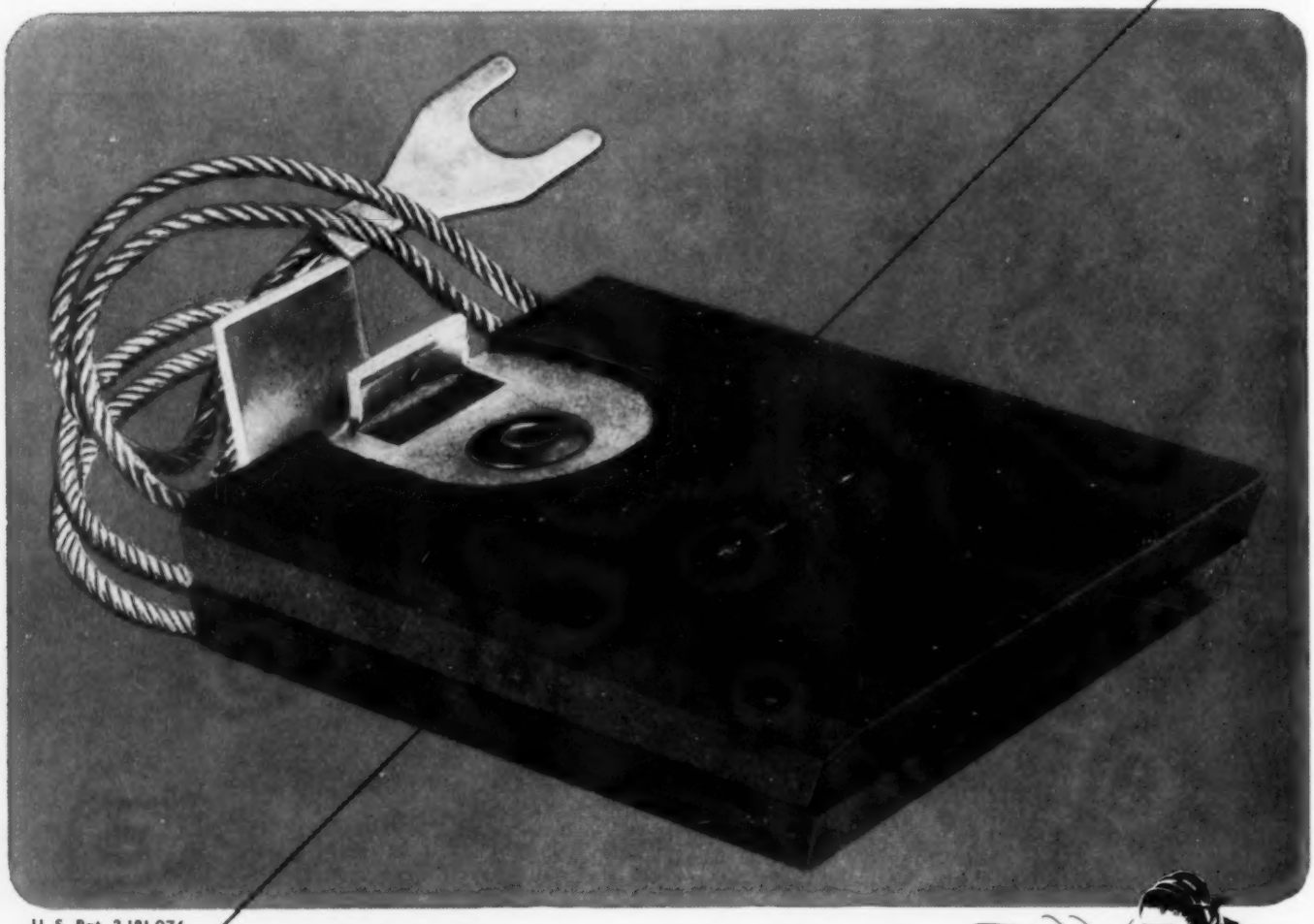
Speer Here...





U. S. Pat. 2,181,076

helps make sound welds here!

Speer carbon brushes are installed in hundreds of motor generator sets because they have good contact and long life... two mighty important brush requisites for dependable arc welding!

No matter what your brush requirements may be, you'll find that Speer's rigid testing under actual service conditions, have made the Speer carbon brush an outstanding performer regardless of load conditions.
For maximum efficiency and smooth, trouble-free performance... insist on Speer carbon brushes for any motor or generator application.

6434

Speer

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brushes · contacts · welding electrodes · graphite anodes · rheostat discs · packing rings · carbon parts

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high ratios?

✳ ONE OF 93

DE LAVAL DOUBLE REDUCTION WORM GEARS

De Laval double reduction speed reducers, consisting of combinations of double worm gear reductions, or helical and worm gear reductions, are available with overall ratios up to approximately 8000 to 1. De Laval single reduction worm gear speed reducers are available in ratios up to 90 to 1. If high ratios are your requirement, worm gear speed reducers are the answer—particularly if space is limited and reliability is important. A De Laval representative will help you pick the right size and type.

✳ This double reduction De Laval Worm Gear Speed Reducer is available in many standard ratio combinations, with horizontal or vertical output shafts and is but one of 93 sizes of standard De Laval Worm Gear Speed Reducers.

Send for Catalog GWB-14-R

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WG-14

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COSTS SLASHED $1,200.00

By Using "C.Q." Giant Refractory Blocks in Battery of Four Soaking Pits

"C. Q." Giant Refractory Blocks of Buckeye Silica Firestone are the most important advancement in the refractory field in the last decade. With them, you know you will have a quicker, easier, more economical soaking pit lining job that will need less masonry workers, last longer and provide much better service.

There is no guesswork to it. Installations already in use show savings anywhere from $800.00 to more than $2,000.00 wherever "C. Q." Giant Refractory Blocks have been installed. These oversize blocks of Buckeye Silica Firestone are proving so popular that masonry departments are planning on converting to them 100% just as soon as each soaking pit has to be relined.

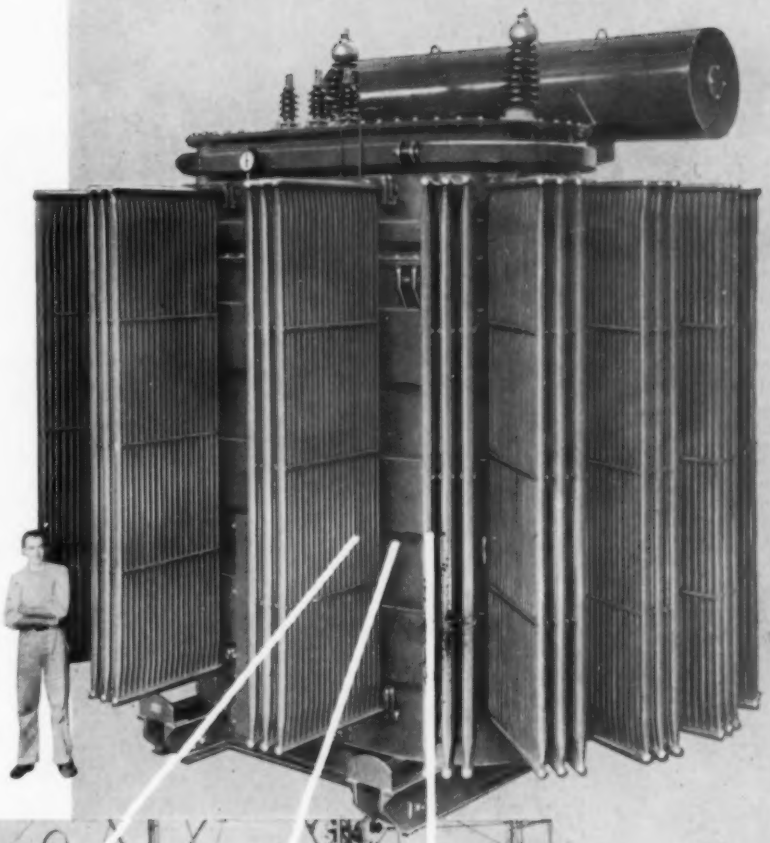
"C. Q." engineers will help you take advantage of the proven economy of this new, modern idea. Write or phone today.

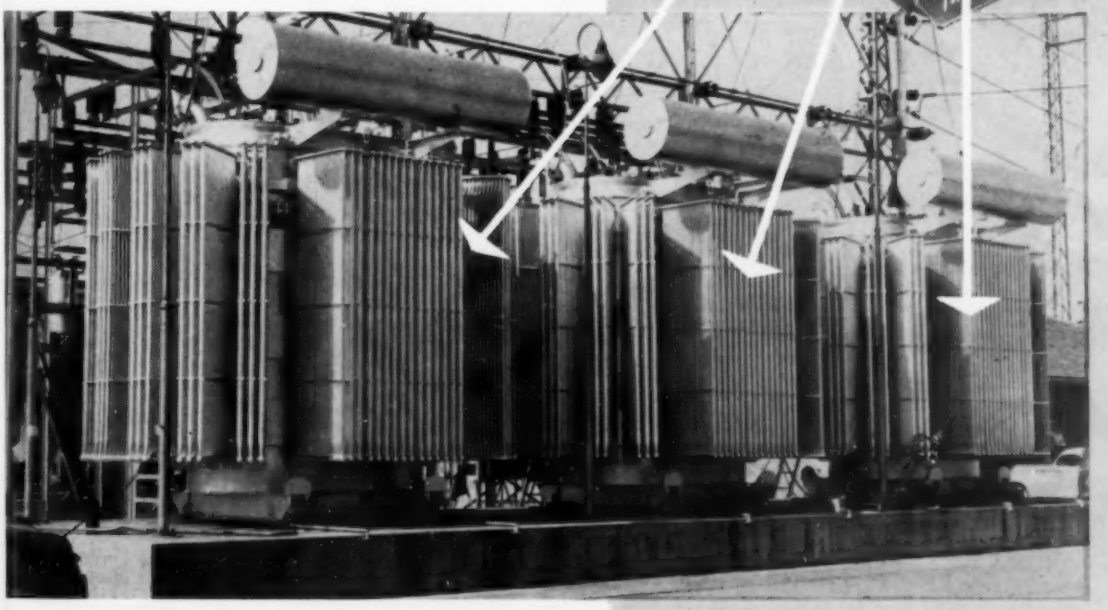
THE CLEVELAND QUARRIES COMPANY
REFRACTORY DEPT.
1740 E. Twelfth Street CLEVELAND 14, OHIO

BUCKEYE
"FOR THAT EXTRA SERVICE"
SILICA FIRESTONE

3 OF A KIND makes 75,000 KVA

Each year more and more Pennsylvania Power Transformers in a greater variety of sizes and voltages are being specified by leading utilities throughout the country. Pennsylvania is now filling orders for transformers with ratings of 35,000, 70,000 and 105,000 Kva. Transformers of all voltage classes up to and including 230 Kv are regularly manufactured in Pennsylvania's completely equipped plant. Pennsylvania is now also manufacturing a full line of Step Voltage Regulators, Unit Substations, and Load Ratio Control Transformers.





Three single phase Pennsylvania Transformers —each rated 20,000/25,000 Kva, 69 Kv—recently installed in an important sub-station of a Western Utility.

Pennsylvania TRANSFORMERS

Pennsylvania
TRANSFORMER COMPANY
Canonsburg, Penna. · Greater Pittsburgh District

NOW... One Grease applications in the

"The MILLION STROKE Industrial Grease"

A grease that will stand 100,000 punishing strokes of the ASTM Work Tester has been considered a superior lubricant.

In a deliberate attempt to break down Shell Alvania Grease, on the same tester, the run was extended . . . 200,000 . . . 300,000 strokes . . . 500,000 strokes! Finally, at one million strokes the test was discontinued, because this grease would not break down—it was still a fit lubricant both in appearance and consistency.

Combines all these important advantages!

1. Higher mechanical stability than *any* conventional grease at operating temperatures.

2. Pumpable at low temperatures—even in unheated storage.

3. Stable at high temperatures—superior to the best "soda" greases.

4. Impervious to water—excellent resistance to washing out.

5. Longer Service Life—reduced consumption.

SHELL ALVANIA . . .

will service all grease majority of plants

SHELL ALVANIA GREASE

Shell Alvania is the one grease that will service all grease applications in most industrial or processing plants. It is already making important changes in maintenance and purchasing practice.

Because Shell Alvania, a patented grease, combines *all* of the advantages of the many special purpose industrial greases, this new lubricant does a highly efficient job in most any application you can name.

Gives you these plant savings:

1. **Extends TIME between greasings**—lasts longer . . . stays in bearings for much longer periods.
2. **Low-cost application**—fewer servicings per year and *only the one grease to handle at any time.*
3. **Simple inventory**—Shell Alvania Grease replaces up to 20 brands formerly required.
4. **Greater safety**—less chance of applying the wrong grease to expensive machinery.
5. **Better protection**—against heat, cold and moisture.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, N. Y.
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

The "MILLION STROKE" Grease

FOR OVER FORTY YEARS

THE BEST GEARS MONEY CAN BUY

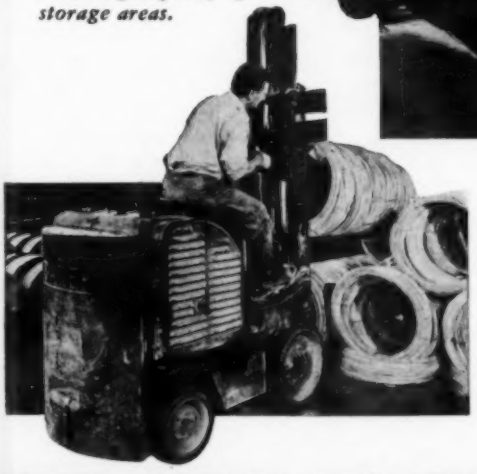
$17.00 Handling Job Cut to $1.40 with BAKER TRUCK

Same Truck helps Johnson Steel & Wire Co. improve worker efficiency and increases storage capacity 40 to 50%

With 48" forks brought together to form a ram, truck unloads coils weighing 300 lbs. each, six at a time.

Steady production is maintained by keeping machines supplied with material, despite limited floor space.

With no extra cost or effort, coils are stacked 2 and 3 high, thus doubling capacity of storage areas.



A Baker 3000 lb. Fork Truck unloads and stores coils of incoming wire from boxcars in 45 to 60 minutes per car. This job formerly took four men from four to five hours. Savings: 15-19 man hours or $15.60 per car. Since cars can be unloaded immediately upon arrival, rusting of wire from exposure to outside air is eliminated.

By keeping draw benches and machines supplied with wire as needed to keep production going at top speed, efficiency of workers has been increased. Moreover, the truck stacks coils 2 and 3 high, thus increasing existing storage capacity 40 to 50%. In addition safer and better working conditions have resulted, aisles are kept clear, and men have been released from heavy back-breaking handling jobs to productive work.

A Baker Material Handling Engineer will be glad to show you how similar benefits can be gained in your plant.

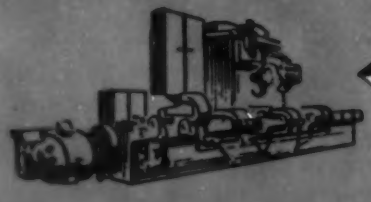
BAKER INDUSTRIAL TRUCK DIVISION
of The Baker-Raulang Company
1229 WEST 80TH STREET • CLEVELAND 2, OHIO
In Canada: Railway and Power Engineering Corp., Ltd.

Baker® INDUSTRIAL TRUCKS
LOW-LIFT · HY-LIFT · FORK & RAM · CRANE · TRACTOR · PLATFORM

Modernization is a *Must!*

USE BILLETEERS!

Resounding hammer of the village blacksmith rings through early American industrial history. But would you trade your modern forging equipment for a brawny arm and a heavy sledge? *No! —Not for a whole battery of them!* In billet-cleaning, like forging, new methods pay handsomely. Here's how today's proven production of the Bonnot Billeteer stacks up against out-moded hand methods of billet-conditioning.



Engineered for Improved Production . . .

MANUAL CHIPPING	BILLETEER CONDITIONING
Labor costs high.	Labor costs reduced as much as 56% .
Slow, grueling operation.	Easy machine operation; does better work ten times faster.
Partial chip salvage.	Chips 100% recoverable.
Extremely hazardous.	Outstanding safety records such as 490,000 manhours with only one disabling accident.
Large inventory needed.	Minimum inventory and dependable, scheduled production.
Employee turnover high.	Fewer personal problems because men like to operate Billeteers.
Jitters and fatigue drastically limit span of worker's usefulness.	By contrast, rugged Billeteer stands the punishment—in many cases exceeding 100,000 hours of efficient performance, and with no absenteeism.

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO

Let us show you how much the Bonnot Billeteer can save you in billet-conditioning and manpower costs – *Write today!*

Speeding SHEET AND TIN PLATE *Production* IN THE FAR WEST

10 FURNACES
30 BASES
in a single installation

SWINDELL-DRESSLER

Recirculating
RADIANT TUBE
ANNEALING FURNACES

Ten Swindell-Dressler bell type annealing furnaces serve 30 bases in this recent installation—annealing cold-reduced steel in coils 56" O.D., piled four to a stack, eight stacks to a base. Each furnace employs 40 recirculating radiant combustion units, and measures 13'2" wide, 28'1" long, 13'9" high (interior). • *May we discuss an efficient solution to your own annealing problem?*

SWINDELL-DRESSLER Corporation
DESIGNERS AND BUILDERS OF MODERN INDUSTRIAL FURNACES
PITTSBURGH 30, PA.

When detecting temperature by radiation method . . .

● ***Hermetically sealed construction*** **at lens, window, and leadwires keeps out dust and gases. New design guards inherent accuracy and stability, even with high or rapidly changing Rayotube housing temperatures.**

● ***Quick-sighting optical system*** **lets user select desired target easily, and then check the sharply-defined area which the Rayotube sees. Increased sharpness is also of benefit when radiation comes from end of a closed tube.**

Which do you want?

If you already know about Rayotubes, we'll send you brief material to bring you up-to-date on the new model. If you want the full story on all Rayotubes, ask for Cat. N-33B. Please specify. Write Leeds & Northrup Company, 4942 Stenton Ave., Phila. 44, Pa.

Built to work with all Micromax and Speedomax Rayotube instruments, this new Rayotube is an important advance in radiation pyrometry. Present users of Rayotubes, as well as future ones, will find this completely new, advanced design detector unusually easy to apply, especially to such equipment as slab furnaces, soaking pits, open-hearths, ceramic kilns . . . wherever operating conditions are severe.

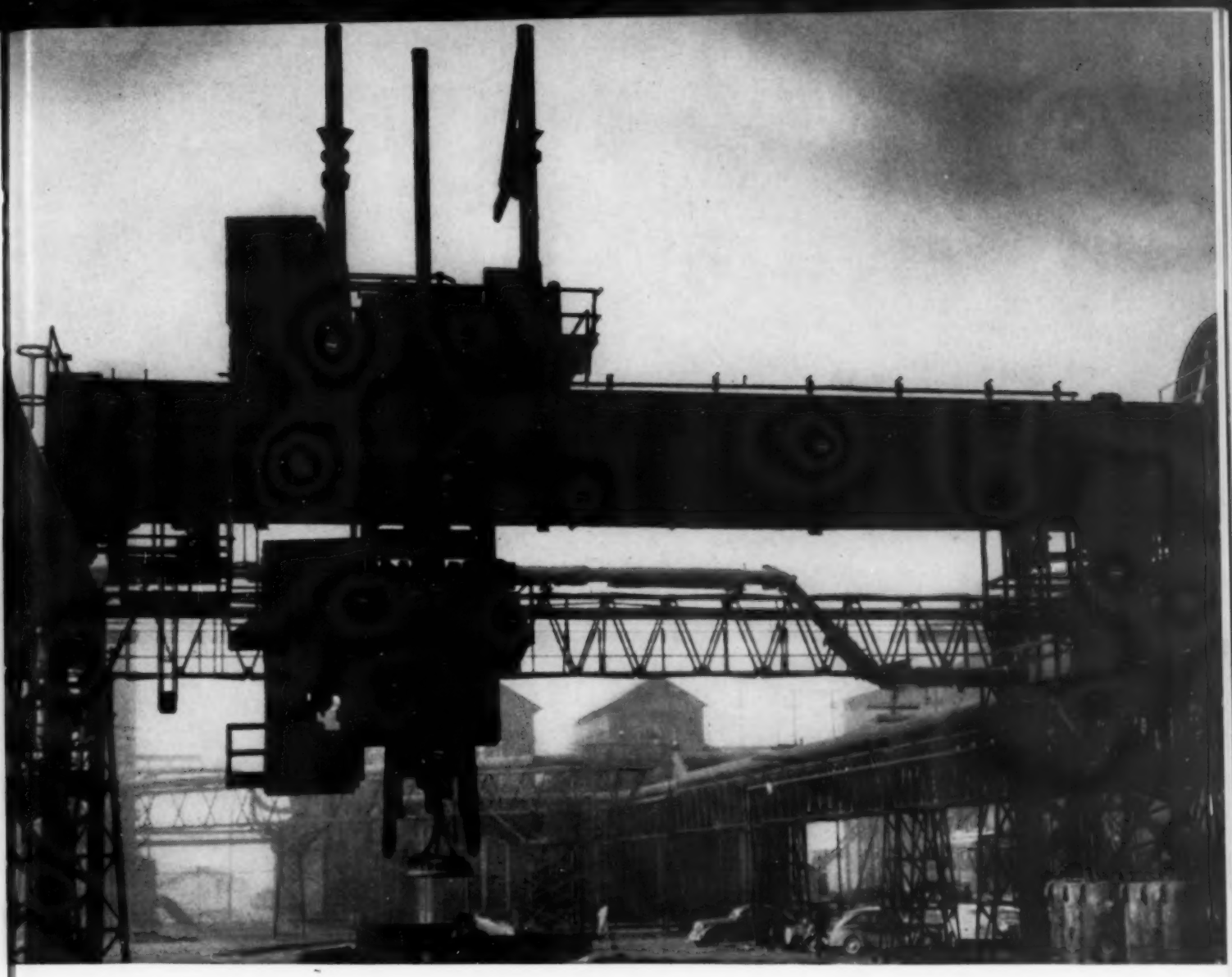
Purposely designed for easy, low cost replacement, the new Rayotube fits all existing Rayotube mountings. This unit requires no protection against high ambient temperature unless its housing temperature exceeds the very high figure of 350 F. Below that point, any previously installed water- or air-cooling can simply be turned off or disconnected.

Temperature control engineers will welcome these and many other new concepts of design built into this highly versatile temperature detector.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl. Ad NS3(1)



only *Alliance* does so many jobs so well

● Industry the world over has asked us to move unusual loads . . . slabs, ingots, hot metals, raw materials, finished products. And we've always come up with a crane that does the job safely, quickly, easily.

Naturally, the types of cranes and equipment we've built are unusual . . . ladle cranes, gantry cranes, well, just look at the list at right. As a result, Alliance's broad engineering experience and application skills benefit you handsomely.

Today thousands of Alliance cranes are tugging, hoisting, shifting tremendous loads safely, rapidly, economically. They maintain smooth-flowing production schedules week-in, week-out, year-in, year-out. **In short, heavy industry depends on big Alliance cranes.**

Always rely on experienced, skillful Alliance to give your plant rugged, reliable, extra lifting power.

Alliance

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SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET
CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES
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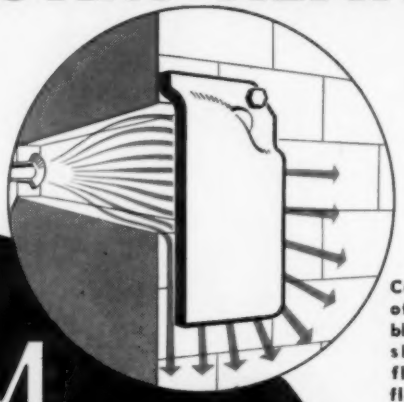
FASTER, MORE UNIFORM HEATING

in COVER-TYPE FURNACES with the—

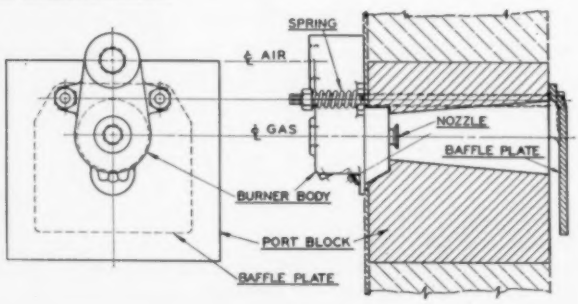


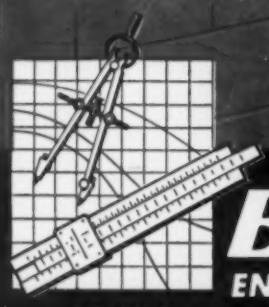
Cutaway view of burner, port block and baffle, showing how flame is deflected.

BLOOM *Baffle-Type* BURNER

Flame is deflected horizontally and downward, forming a sheet of flame across lower part of furnace wall. The Baffle prevents direct impingement of flame on inner cover. Concentration of heat at the bottom of the furnace assures fast, uniform heating of the entire charge. After one year of continuous operation, the Baffle Plate shows no deterioration.

The result: greater production, improved quality, less maintenance.

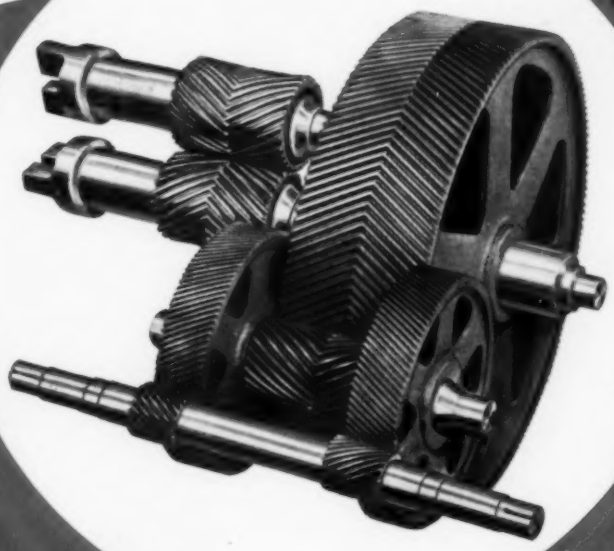




BLOOM
ENGINEERING CO., INC.
857 W. North Avenue Pittsburgh 12, Pa.

Send for Descriptive Bulletin giving complete details.

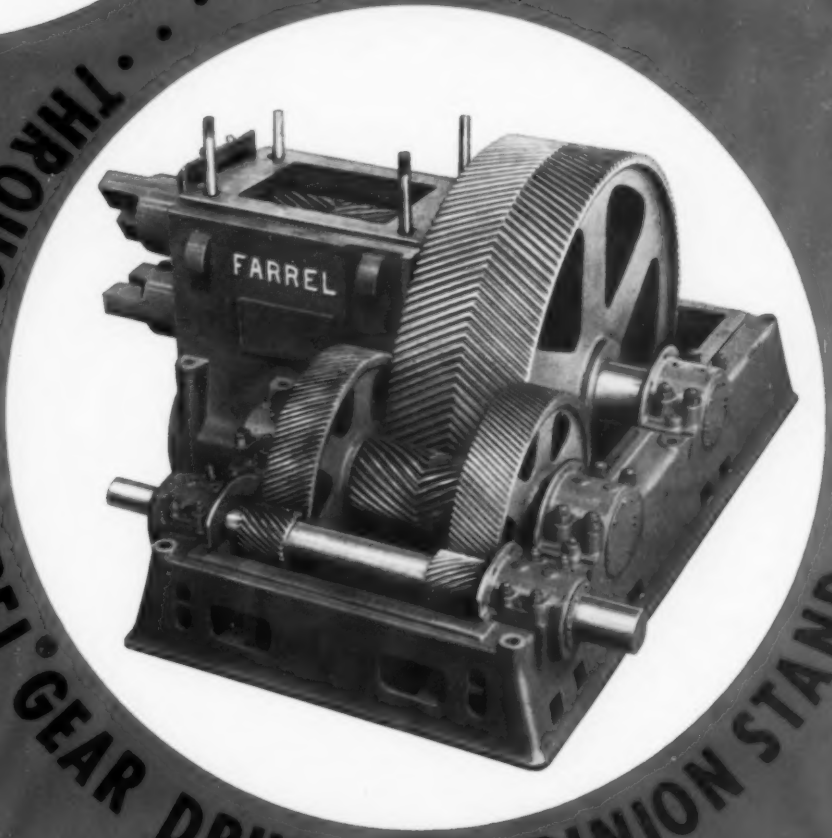
★HERE'S WHY POWER FLOWS SMOOTHLY . . . . THROUGH A FARREL® GEAR DRIVE AND PINION STAND



The gears and pinions used in a Farrel combination mill drive are all precision generated by the famous Farrel-Sykes process. This method of generation assures extreme accuracy of tooth spacing, contour and helix angle, which pays off in smooth, uniform power flow.

In the drive illustrated, the first reduction consists of split (divided) double helical gears. The second reduction gears and the mill pinions are the Farrel-Sykes continuous-tooth herringbone type. This makes a compact gear arrangement which distributes the load uniformly and requires minimum floor space.

With all shafts mounted in roller bearings, friction losses are reduced to a minimum. Efficient operation is further assured by an effective lubrication system.



Designed to suit individual requirements, Farrel rolling-mill drives and pinion stands — separate or combination units — are available in any capacity. Farrel engineers will be glad to supply full information for any specific application.

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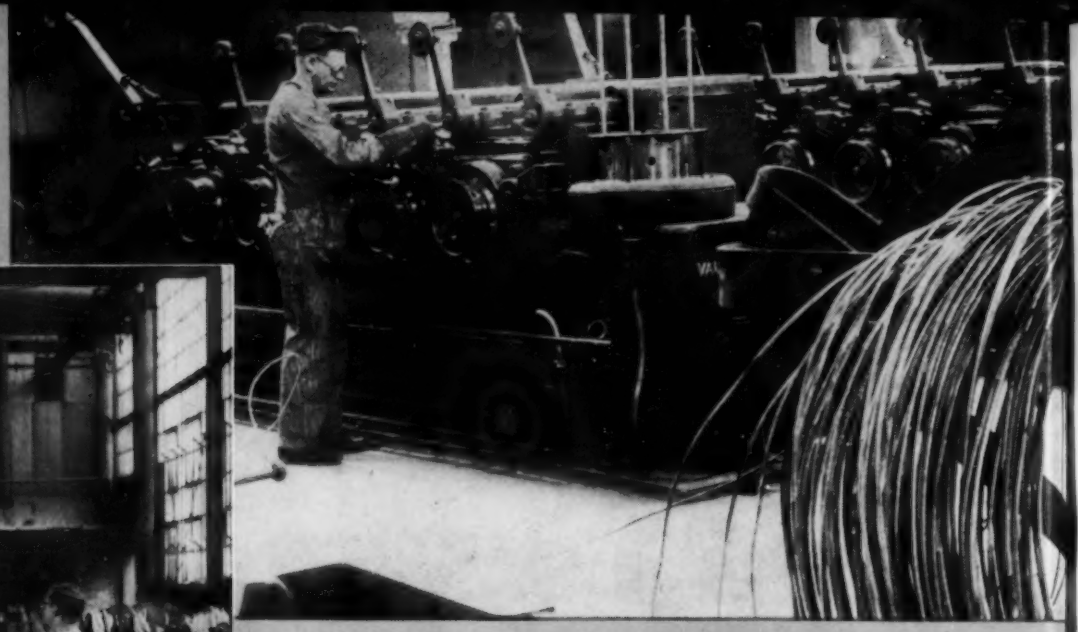
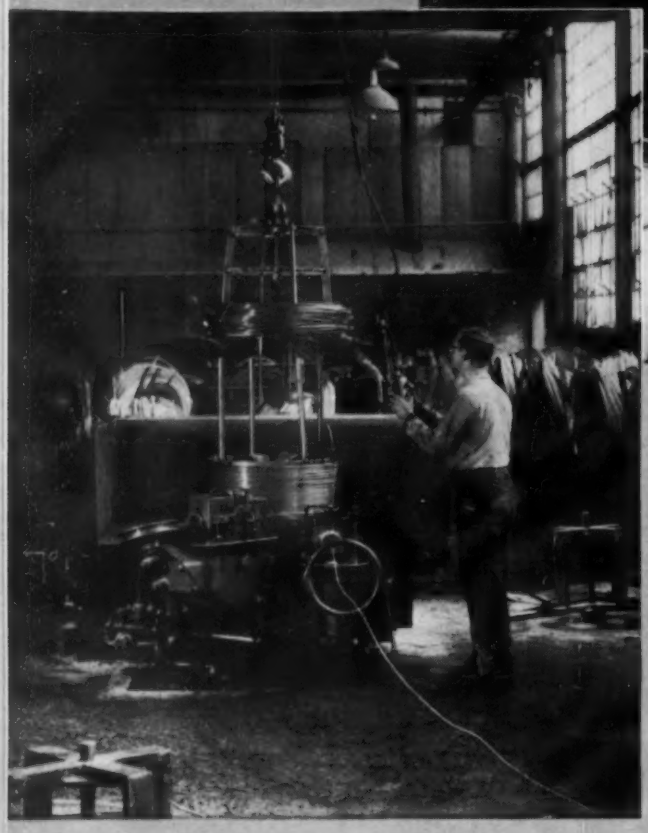
VAUGHN MOTOBLOX

VAUGHN MOTOBLOC

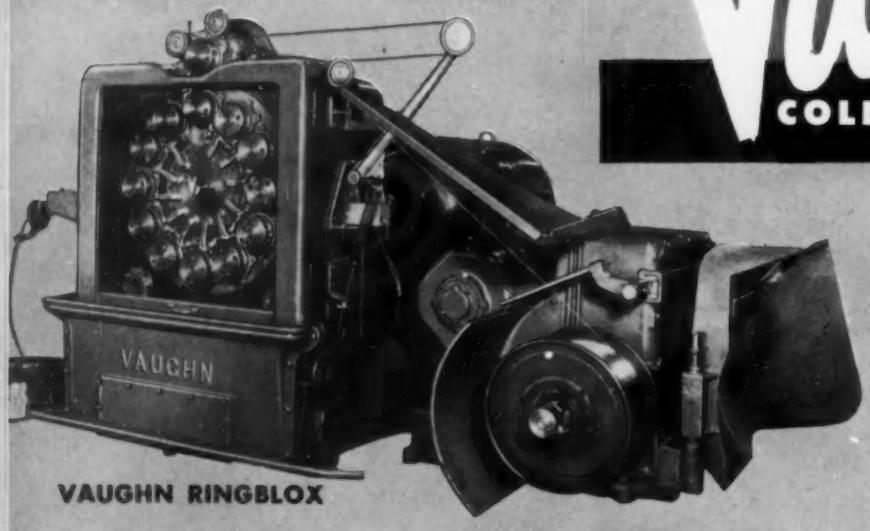




A Type and Size for Every Kind of WIRE BAR or TUBE · · ·

Vaughn

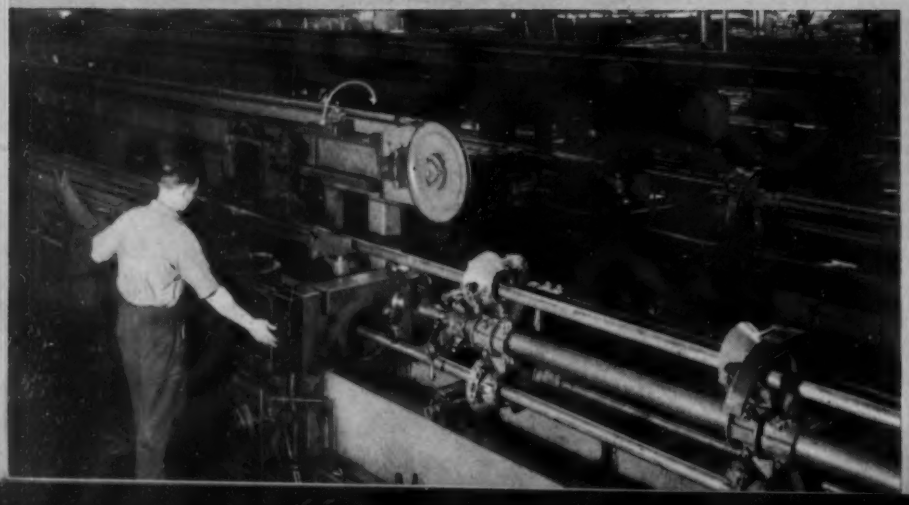
COLD DRAWING MACHINERY



VAUGHN RINGBLOX

VAUGHN Machines are supplied in types and sizes to handle every cold drawing requirement of the metal-working industries—at higher rates of speed, with superior versatility, maximum safety and convenience. *May we match your needs with facts on the right Vaughn units?*

Vaughn, Motobloc, Motoblox—Registered U.S. Patent Office



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Cuyahoga Falls, Ohio, U.S.A.

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Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

VAUGHN DRAW BENCHES

3 Production Benefits from this Remarkable Instrument

1. Closer Combustion Control
2. Better Quality Control
3. Productivity Raised

The Cities Service Heat Prover Analyzes Combustion Atmospheres of Industrial Furnaces

Regardless of type or size of furnace, atmospheres vital to steel production are quickly, accurately and completely analyzed. With this one remarkable instrument it is easy to determine how much fuel is wasted, whether excess oxygen may be present to cause scaling and how much energy is wasted in uselessly heating excess air.

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stop coupling failures!

FIND OUT HOW *Koppers Engineers Eliminate Needless Downtime* IN YOUR PLANT!

These FAST'S COUPLING *Services save you money!*

UNSURPASSED ENGINEERING . . . Koppers engineers are acknowledged the best in the industry. Their practical knowledge, backed with 30 years' coupling experience, is at your service!

IMMEDIATE DELIVERY . . . All standard types and sizes are available for immediate delivery from "on hand" stocks. In case of emergency, just wire factory for special rush delivery!

LOWEST COST PER YEAR . . . Fast's Couplings will outlast equipment they connect if properly maintained. Their cost may be spread out over 25 years or more, offering you lowest coupling cost per year!

Before your plant is harassed by needless coupling failures—*call on Koppers!* Only Koppers offers you a two barreled solution to coupling problems: Fast's Couplings, the original gear-type coupling—and Koppers Engineering Service, acknowledged the finest in the industry!

For *30 years,* Fast's Couplings have been industry's standard for *long life* at *low cost.* Now, in addition, when you specify Fast's you get the *extra* advantage of Koppers valuable Engineering Service. Koppers engineers, backed with 30 years of Fast's Coupling experience, study your problem. Then show *which* Fast's Coupling you need (and more important) *why you need it!*

Only Koppers can offer you both Fast's Couplings and unexcelled engineering service—so before you buy *any coupling,* get the complete story on Fast's. Full details are contained in the Fast's Catalog. For your free copy, send the coupon today!

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in cable insulation... there's nothing like | NATURAL RUBBER

...and, in natural rubber, there's nothing like | WILD UP-RIVER FINE PARA

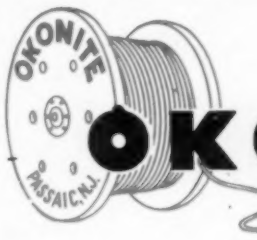
The first, and most important, thing about cable insulation made with natural rubber is that its long life and stability *have been proved dependable* over a period of nearly 75 years.

This is the record of Okonite cables made with one particular type of natural rubber—wild Up-River Fine Para from South America's Amazon Valley. It's the only kind of rubber used for the insulation in Okonite and Okolite cables. And it's one basic reason why the insulation in countless Okonite cables, examined after 20, 40, and even 50 years in service, has stayed elastic and electrically sound.

Though Okonite research engineers were the first to employ man-made synthetics in wires and cables, their experience has taught them that these materials have limitations as well as advantages. This same long experience has also taught them that you dare not place the same reliance on *anticipated performance* based on laboratory tests that you can on *established records* gained from years of operating insulated cable under actual service conditions.

That's why Okonite continues to make cables with NATURAL RUBBER—Up-River Fine Para rubber—and recommends them with full confidence wherever long life and circuit security are first considerations.

If you would like to have more information on the importance of cable insulation made with natural rubber, just ask for Research Publication IS-1014. The Okonite Company, Passaic, N. J.



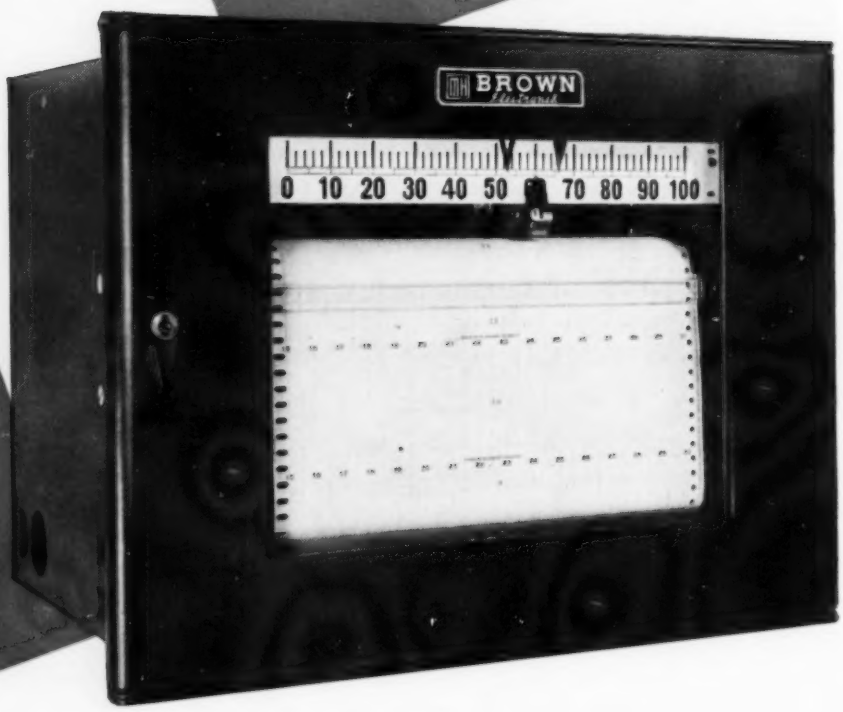
THE BEST CABLE IS YOUR BEST POLICY

OKONITE SINCE 1878 *insulated wires and cables*

B147

another Pace-Setter for the ElectroniK LINE

...A VERSATILE MULTI-POINT STRIP CHART CONTROLLER



Here's the last word in multiple controllers . . . fully field tested and proved . . . ready to go to work on your multiple-zone furnace or other heat processing equipment requiring mixed types of control.

Check these outstanding advantages of the *ElectroniK* Multi-Point Controller:

- *Affords multi-point recording, with a great variety of controls at two different temperatures.*
- *Has ample speed for stabilized records and control.*
- *Combines proportional and contact types of control as required.*
- *Conserves panel space by combining many functions in one instrument.*
- *Possesses all the* plus *features of the popular ElectroniK Potentiometer, including unmatched accuracy and sensitivity and automatic standardization.*
- *All components are manufactured by Honeywell . . . and are backed by the nation-wide Honeywell organization.*

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WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

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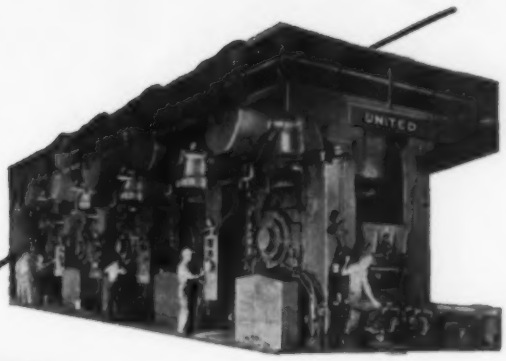
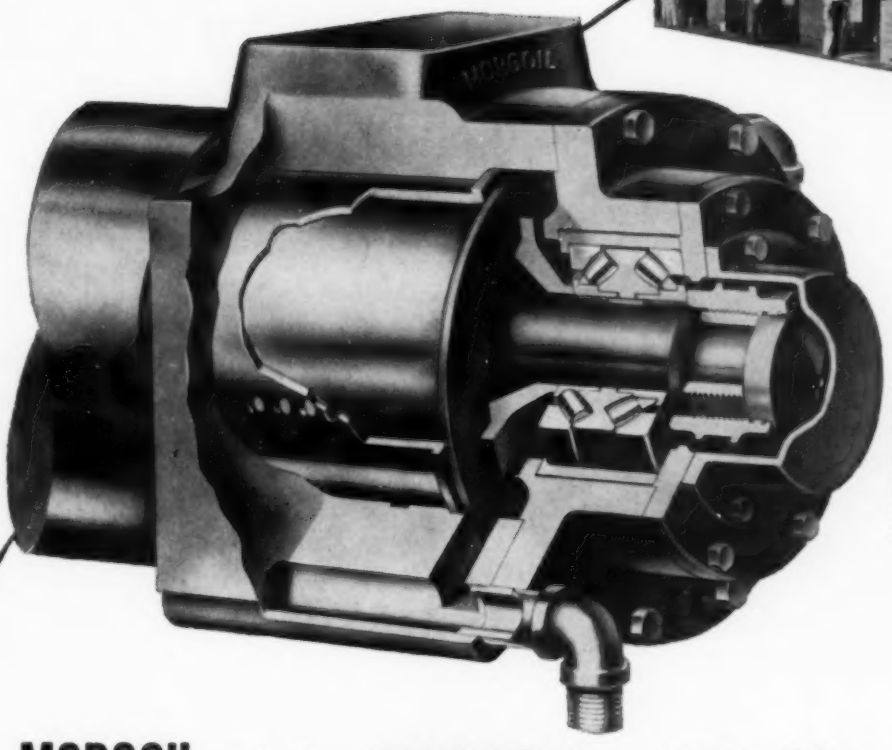




The SKF double-directional Spherical Roller Thrust Bearing has the *high* thrust capacity and alignment characteristics required for grueling service. It has the ability to run at sustained high speeds . . . as much as 10,000 feet a minute . . . with only a very low friction torque.

MORGOIL *picks* SKF *for 542 Morgoil Bearings in new, high-speed strip mills since 1946*

Since 1946, Morgan Construction Company has installed 542 Morgoil Bearings, incorporating the SKF double-directional, spherical roller bearings, in high-speed hot and cold mills. ***And day by day, the list grows.***

Actually, SKF Bearings as the thrust units in Morgoil Bearings go back to 1939. That year saw the initial installation of the conventional-type Spherical Roller Bearing on "Morgoils." Now, there are, in addition, the "steep angle" spherical roller bearings and angular contact ball bearings.

Morgoil and SKF are standing the gaff in practically every major steel plant in the country . . . such as Weirton, U. S., Jones & Laughlin, ARMCO and many others. Abroad, they're on the job, too. Such outstanding installations prove that SKF, through constructive engineering, anticipates the needs of industry. ***SKF Industries, Inc., Philadelphia 32, Pa., the Pioneers of the Deep Groove Ball Bearing—Spherical Roller Bearing—Self-Aligning Ball Bearing.*** 7051

SKF

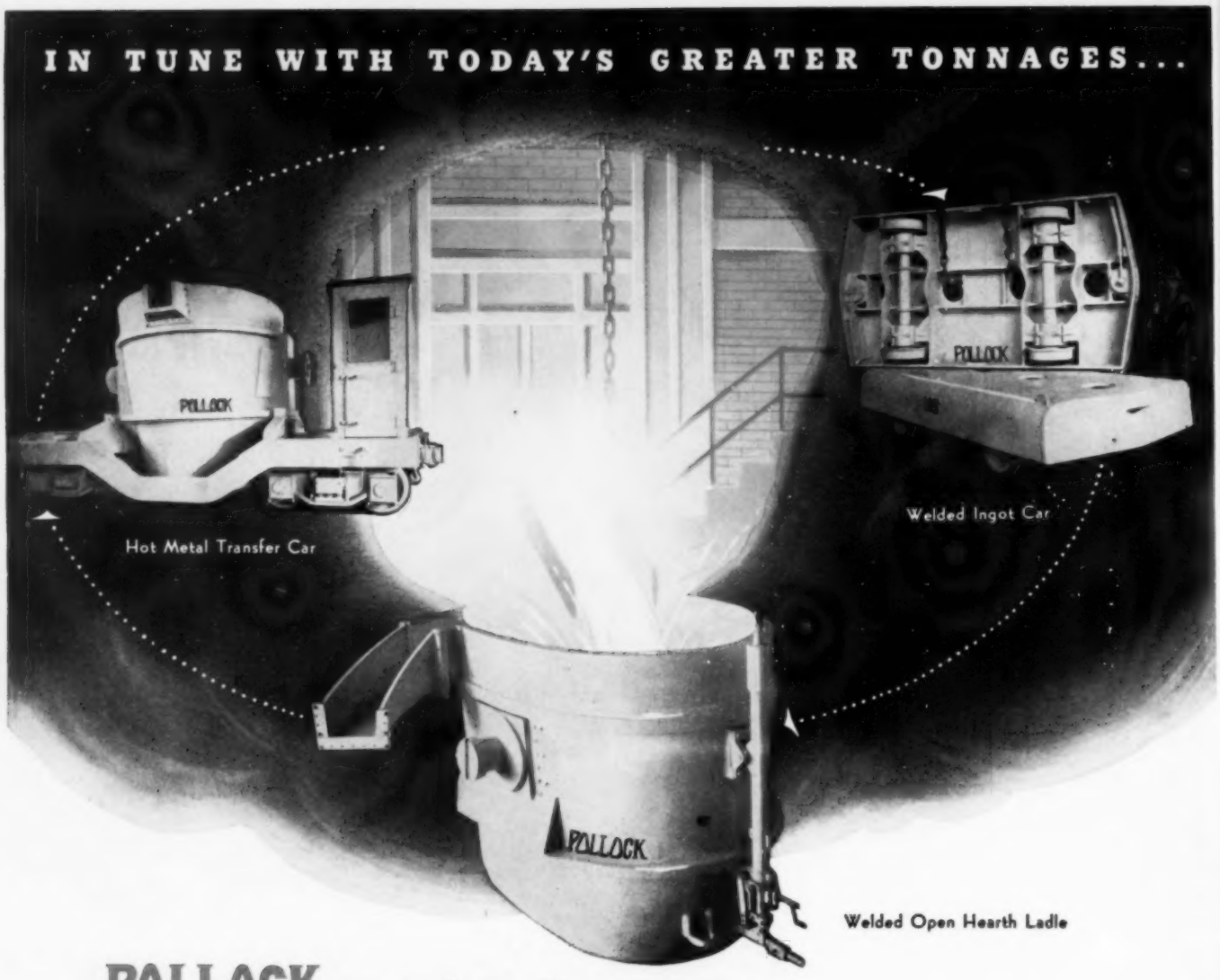
BALL AND ROLLER BEARINGS

8 REASONS WHY SKF IS PREFERRED BY ALL INDUSTRY

INTEGRITY — CRAFTSMANSHIP — METALLURGY — TOLERANCE CONTROL

SURFACE FINISH — PRODUCT UNIFORMITY — ENGINEERING SERVICE — FIELD SERVICE

IN TUNE WITH TODAY'S GREATER TONNAGES...



POLLOCK ***open hearth equipment helps increase your production***

● Do you need new ladles and transfer cars to keep up with increasing production demands? Then let Pollock Company engineers make a study of your open hearth needs, and recommend the equipment best suited to your plant.

Pollock was first to make the all-welded steel ladle and can furnish this type of ladle in any capacity up to 225 tons. Over 350 of these are now in service. . . . Pollock transfer cars have either self-propelled electric motors or are handled by locomotives, and are made in various capacities up to 100 tons.

The Pollock ingot car shown above carries loads up to 150,000 pounds on four wheels, and to move greater tonnages, can be furnished with two 4-wheel trucks. For greater strength and longer life, the top is a one-piece pressed steel plate, and the rest of the car is of all-welded construction. The car has roller bearings and springs, and rolled steel wheels.

Call or write today for complete information on Pollock open hearth equipment

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YOUNGSTOWN · OHIO

STEEL PLATE CONSTRUCTION · ENGINEERS · FABRICATORS · ERECTORS

BLAST FURNACES · HOT METAL CARS AND LADLES · CINDER AND SLAG CARS · INGOT MOULD CARS · CHARGING BOX CARS · WELDED OPEN HEARTH LADLES

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PLAIN CHILLED IRON ROLLS

ATLAS and ATLAS "B" ROLLS

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"X" and "XA" ROLLS

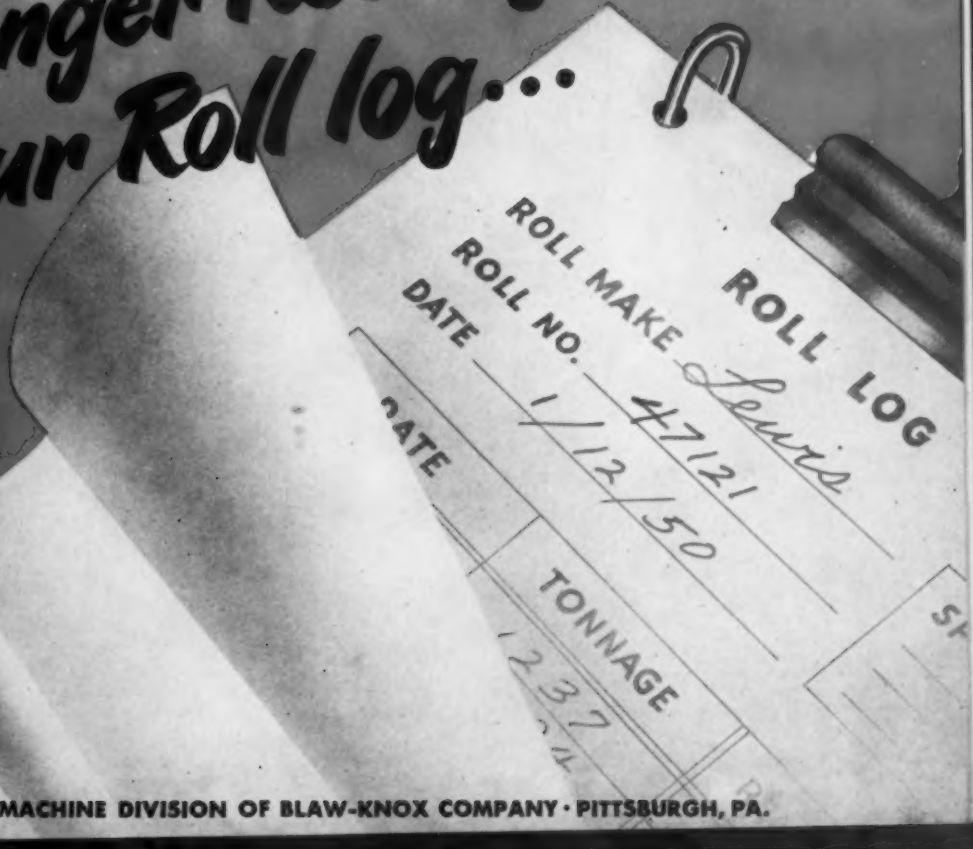
SUPERIOR "X" ROLLS

SPECIAL PROCESS ROLLS

SPECIAL TUBE MILL ROLL

AJAX DUPLEX ROLLS

Spell longer Rolling life in your Roll log...



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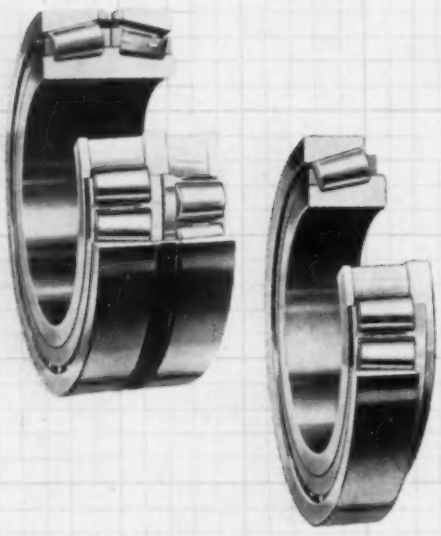
LEWIS FOUNDRY AND MACHINE DIVISION OF BLAW-KNOX COMPANY · PITTSBURGH, PA.

TORRINGTON BEARINGS on Mesta reels help maintain even tension at high speeds



Mesta Machine Company mounts the shaft of its high-speed tension reel on Torrington Tapered and Straight Roller Bearings to help maintain even tension on strip steel at high rolling speeds.

Torrington Bearings hold the reel drum in proper alignment radially and axially, to prevent wobble or end play that would cause coning or uneven coils. Friction drag and wear is minimized to assure uniform tension and sustained concentricity. Tremendous loads are safely carried by these heavy-duty bearings.

To reduce wear and secure long service life with minimum maintenance, be sure to specify Torrington Bearings for your heavy-duty equipment. Our engineers will be glad to work with you on any friction problem.

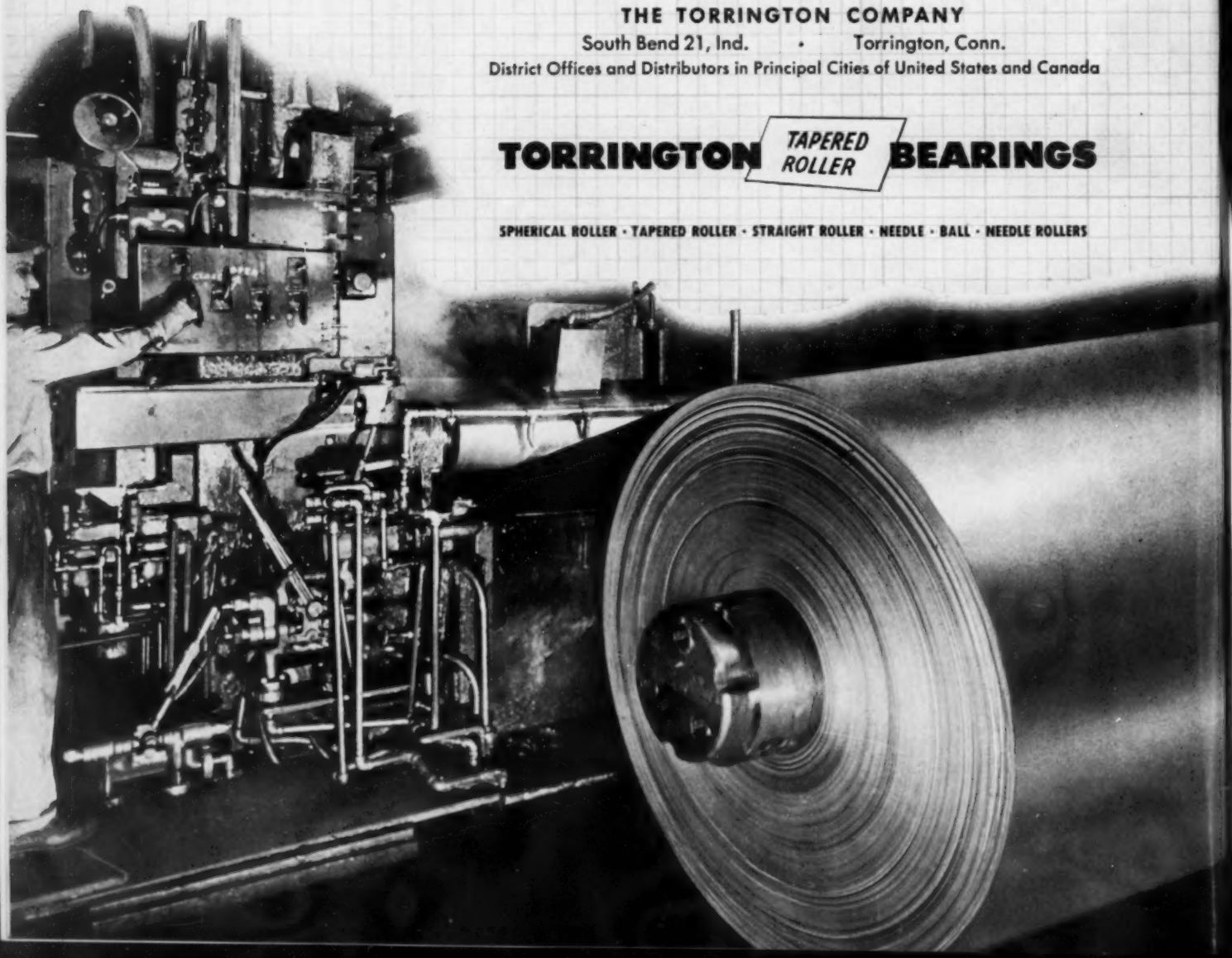
THE TORRINGTON COMPANY

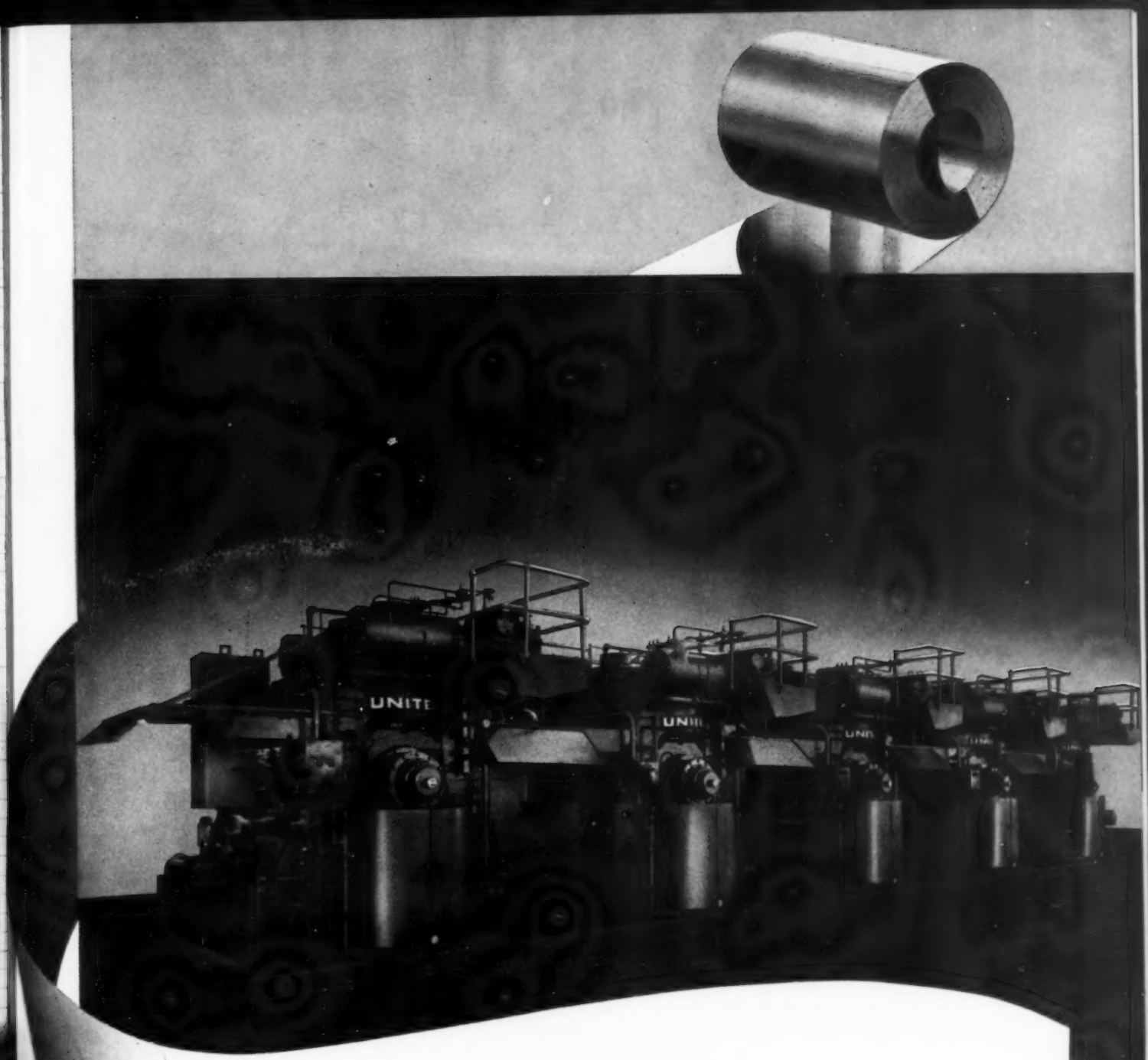
South Bend 21, Ind. • Torrington, Conn.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON *TAPERED ROLLER* **BEARINGS**

SPHERICAL ROLLER · TAPERED ROLLER · STRAIGHT ROLLER · NEEDLE · BALL · NEEDLE ROLLERS





UNITED

5-stand Tandem 4-high Cold Mill

UNITED ENGINEERING AND FOUNDRY COMPANY

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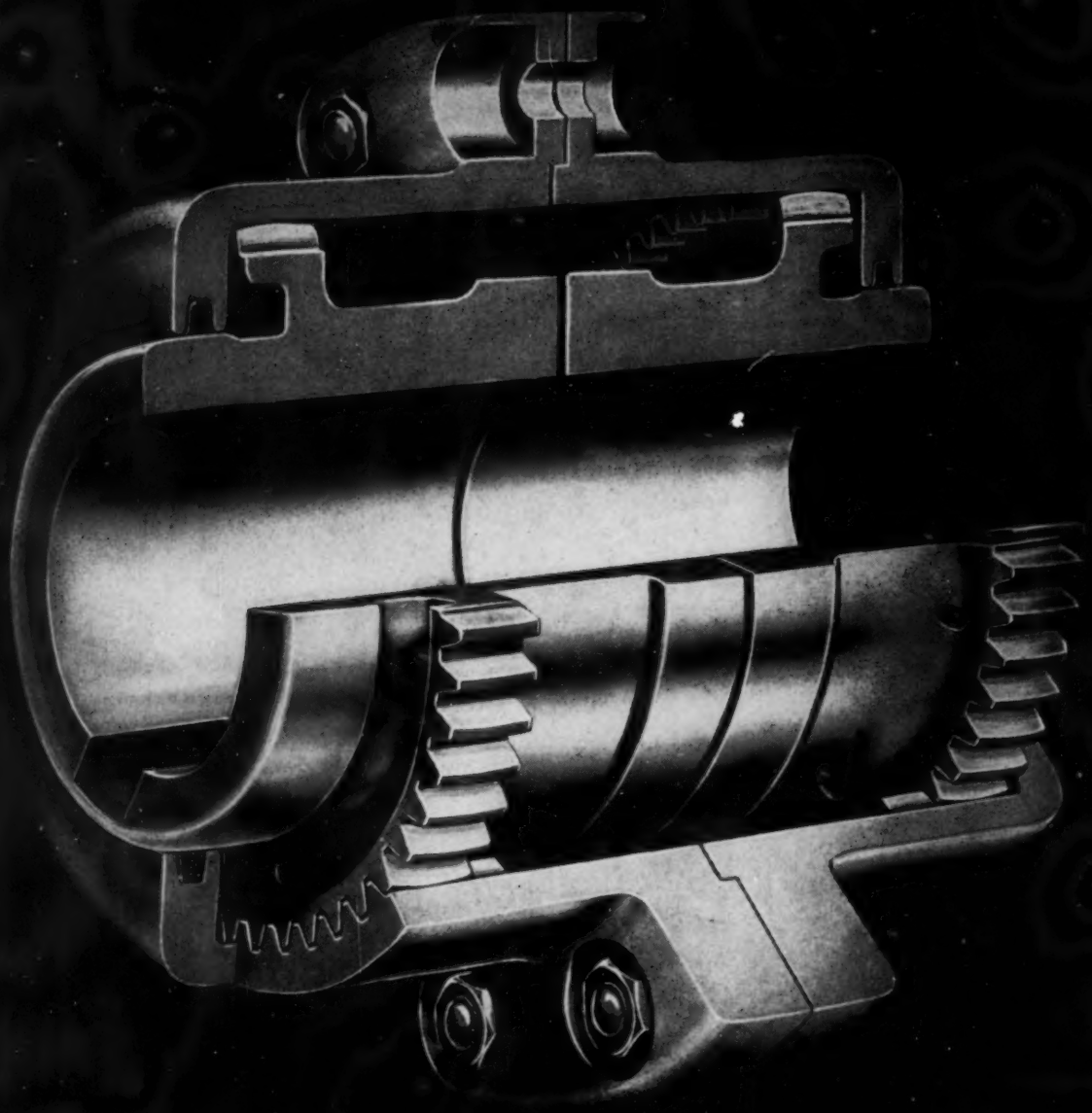
REG. T. M.

Designers and Makers of Rolls and Rolling Mill Equipment

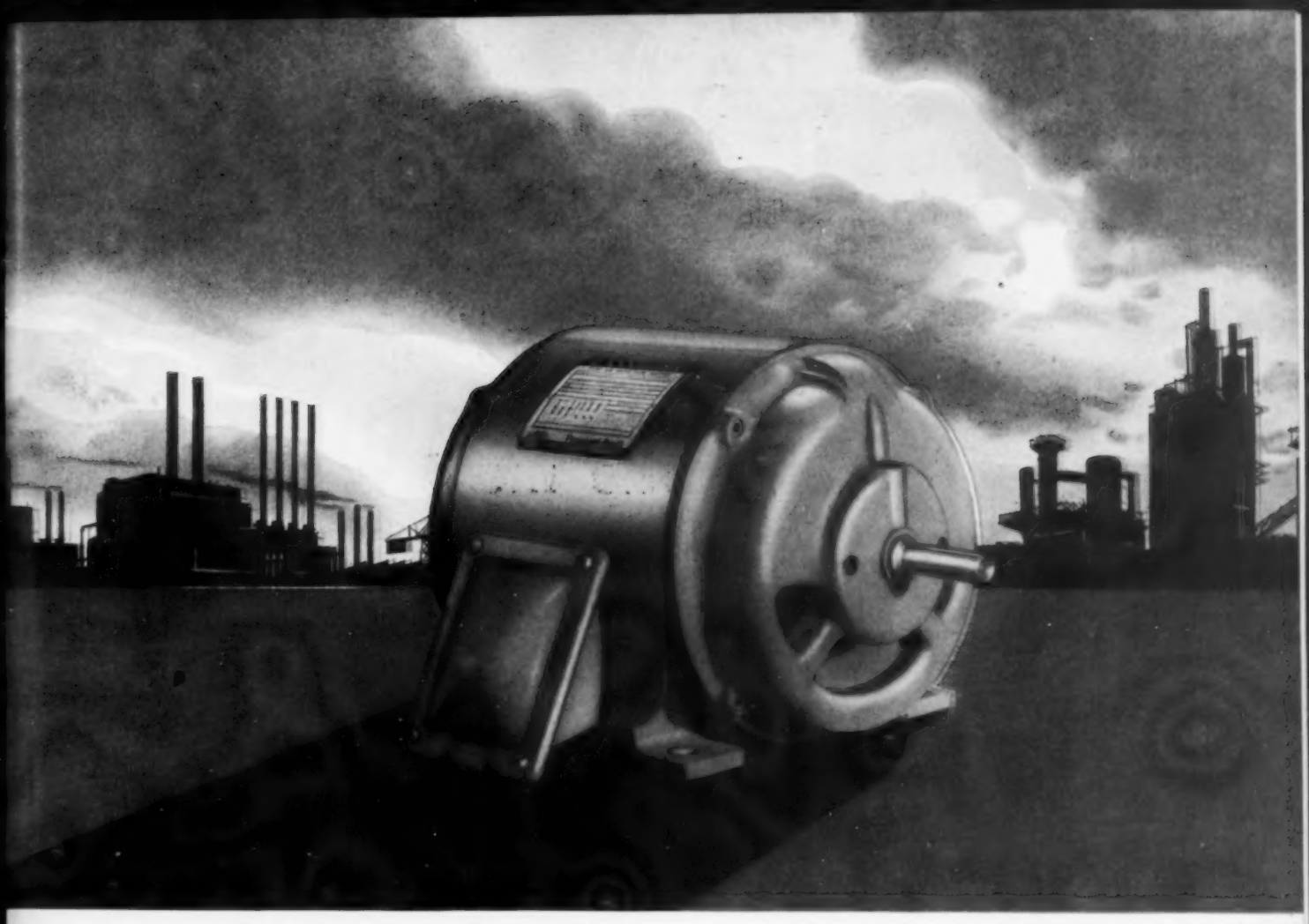
POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY WOODBERRY, BALTIMORE, MD.



Emphatically— all motors are NOT ALIKE!

Some time ago, Reliance startled many people by challenging the old chestnut . . . "all motors are pretty much alike". We have since offered proof that all motors are *not* alike by showing how PRECISION-BUILT A-c. Motors are made differently — to deliver dependable power longer. Reliance is always anxious to have interested visitors see our modern plants and the many extra precision steps which account for the big difference in these motors. But if it isn't practical for you to make such a visit, just call in a Reliance Sales Engineer and you will see pictures, charts and hard facts which are turning more and more motor users into Reliance customers. Ask for Bulletin B-2101.

Sales Representatives in Principal Cities

RELIANCE ELECTRIC AND ENGINEERING CO.

1084 IVANHOE ROAD, CLEVELAND 10, OHIO

RELIANCE *Precision-Built* MOTORS

MADE BETTER IN MANY WAYS

to deliver dependable power . . . *longer!*

Protect the plant and

with CROUSE-HINDS

. . . . . bells, horns, sirens, and visual signals

Raintight signals for non-hazardous locations

The most complete line

Type WH Raintight Horn with Grill

Type WH Raintight Horn with Single Projector

Type WH Raintight Horn with Double Projector

Type FS Raintight Pilot Light Condulet

Continuous production is of vital importance in successful plant operation. Costly shutdowns can often be avoided by Crouse-Hinds signals that give an instant warning of abnormal operating conditions or sound an alarm in case of fire.

A wide variety of signals is necessary to meet the varied conditions in industry. Crouse-Hinds offers a comprehensive line of signaling devices for plant protection and communication . . . . . sirens, horn, bells, and visual signals. Each unit is designed with individual characteristics that make it superior for a particular kind of service. There are Crouse-Hinds signals for use in non-hazardous locations; raintight signals for use where exposed to the weather; explosion-proof and dust-tight signals for use in hazardous locations; signals with a low volume of sound and high power signals that are extremely loud.

You have a definite advantage in selecting signals from the all-inclusive Crouse-Hinds line. It is possible for you to meet the requirements of every location. In noisy areas the character of the noise is of first importance. A signal producing a sound having the greatest contrast to the area noise should always be selected. For example, a horn would not be suitable in

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

Offices: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — Portland, Ore. San Francisco — Seattle — St. Louis — Washington. *Resident Representatives:* Albany Atlanta — Baltimore — Charlotte — New Orleans — Richmond, Va. — Salt Lake City
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First in the field
STANDARD OF QUALITY

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

d maintain continuous production

S Signaling Devices

als for control of operations, and fire protection.

ne of explosion-proof and dust-tight signals for hazardous locations

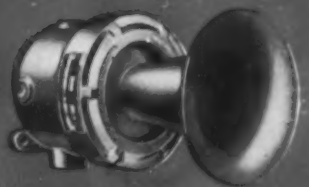
surroundings where a constant hum or whine is present but a bell could readily be heard. A bell would be inadequate in surroundings where the noise is produced by hammering on metal but a horn would give the required contrast.

Careful consideration should also be given to the number of signals required. In general, much better coverage is obtained by even distribution of several low output units than by one or two high output units. On the other hand, a high powered unit is necessary when the sound must be projected a considerable distance from one location.

Crouse-Hinds' line of visual signals includes a variety of pilot lights and also the Visularm, a compact unit used to supervise manufacturing processes. The Visularm will automatically indicate normal and abnormal temperature, liquid level, speed, load, or any other condition which can be electrically coupled to the circuit. An independent circuit is provided in the Visularm to actuate an audible signal.

In Crouse-Hinds' complete line there are dozens of different units from which to choose the items to meet your particular requirements. They are all listed in the Crouse-Hinds Condulet Catalog.

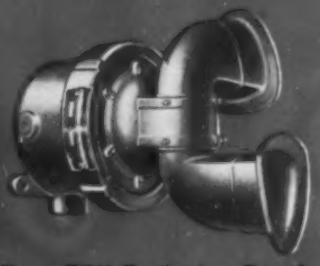
Type ETH Explosion-Proof Resonating Horn



Type ETH Explosion-Proof Standard Volume Horn

Type ETH Explosion-Proof Siren

Type ETH Explosion-Proof High Power Horn with Grill



Type ETH Explosion-Proof High Power Horn with Double Projector

Type EGP Explosion-Proof Panel-Mounting Switch and Pilot Light Condulet

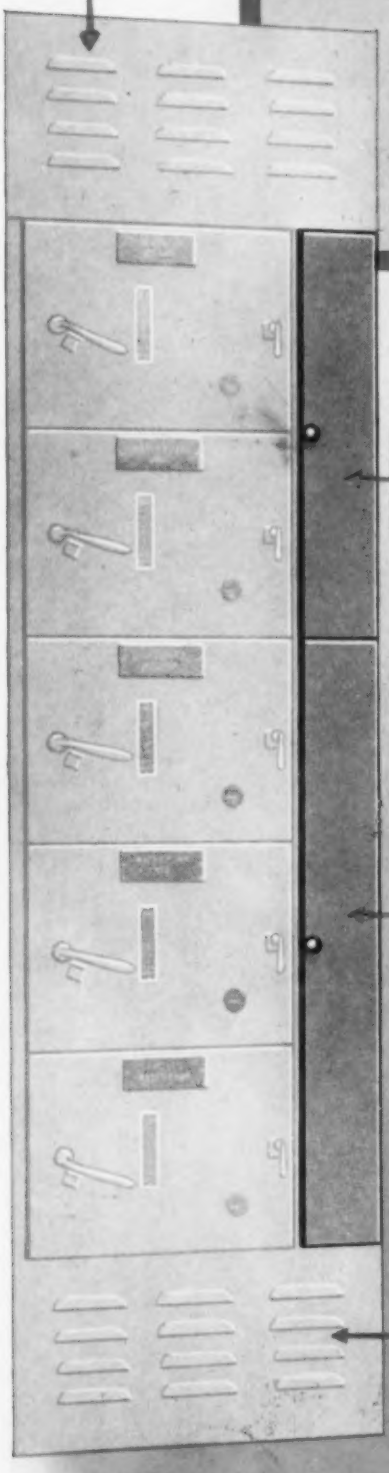
Type EFD Explosion-Proof Pilot Light Condulet

Three Type EKP Explosion-Proof Visularms. One cover removed. Rear view of panel.

Type ESR Explosion-Proof Bell

There's space galore behind this door!

...UNSURPASSED WIRING CONVENIENCE in CLARK CONTROL CENTERS



Just open the 6-inch wiring compartment doors! No trim or baffle plates to remove before wiring!

CLARK CONTROL CENTERS provide all these features for your wiring convenience—

- The LARGEST wiring compartments.
- Plenty of room for BIG HANDS to get in.
- The ONLY Control Centers with SEPARATE DOORS on wiring compartments.
- When equipped with terminal blocks, you still don't have to twist to get in from the sides—it's just a "straight ahead" wiring proposition.

OTHER FEATURES OF CLARK CONTROL CENTERS

- All units have special tight gripping "plug-in" connectors.
- Control units are easily removed.
- All sections are standard in size, and lend themselves to any rectangular arrangement around columns or corners.
- Interlocking handles must be in "OFF" position before control unit doors can be opened.
- Louvres, top and bottom, provide plenty of ventilation.
- Provision for locking control unit doors prevents tampering.

ASK FOR DESCRIPTIVE BULLETIN 6200

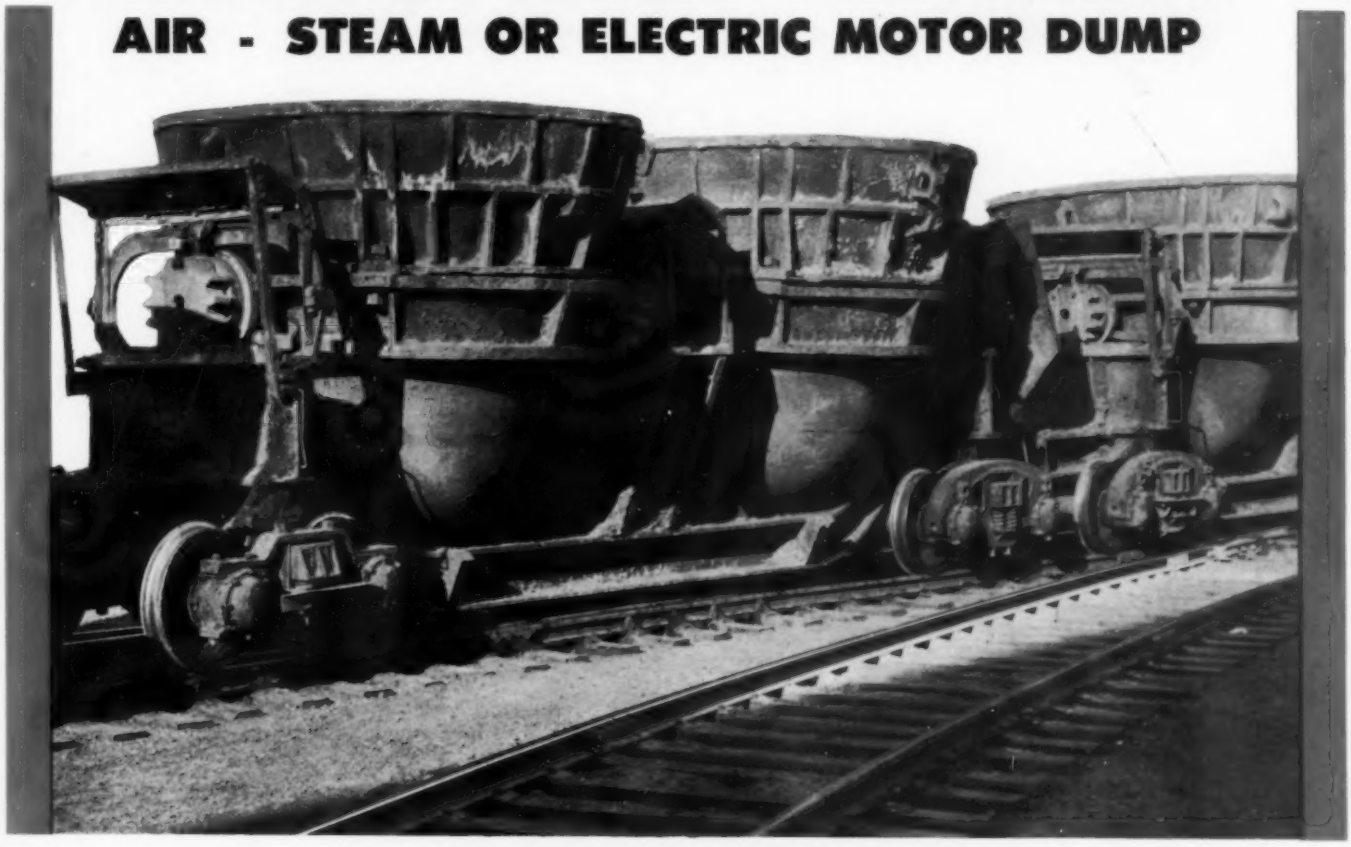
THE CLARK CONTROLLER CO.

ENGINEERED ELECTRICAL CONTROL • 1146 EAST 152ND STREET, CLEVELAND 10, OHIO

TREADWELL

CINDER CARS

AIR - STEAM OR ELECTRIC MOTOR DUMP



800 CUBIC FOOT TWIN POT CAR

Increased Blast Furnace Capacity

REQUIRES

Additional Cinder Handling Equipment

TWIN POT CARS will enable you to HANDLE 20% MORE SLAG on the same track length

M. H. TREADWELL CO., INC.

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Now! a better way

Crucible
TOOL STEEL SELECTOR
COPYRIGHT 1949
IMPACT TOOL
GENERAL PURPOSE
CUTTING TOOLS
GENERAL PURPOSE
SPECIAL PURPOSE
MACHINE CUT MOLDS
PLASTIC MOLDING
COLD HUBBED MOLDS
HIGH TEMPERATURE CASTING ALUMINUM & MAGNESIUM ALLOYS
DIE CASTING
LOW TEMPERATURE CASTING ZINC & TIN ALLOYS
SPECIAL PURPOSE
GENERAL PURPOSE
METAL FORMING—COLD
LONG TIME CONTACT WITH HOT METAL
SHORT TIME CONTACT WITH HOT METAL
METAL FORMING—HOT
CHARACTERISTICS
TYPE
DEPTH OF HARDENING ☆
MACHINABILITY
HEAT TREATMENT
1800 °F HARDEN
0.A QUENCH ★
400 °F TEMPER
60/62 ROCKWELL "C"
INSTRUCTIONS
Each tool steel application falls in one of six major classes. To select the right tool steel for your application:
1. Select the major class on outer ring which covers application.
2. Select the sub-group which best fits the application.
3. Set arrow on each grade in the sub-group and note its characteristics and typical heat treatment.
4. Select the tool steel which, in your judgment, is required.
NOTES
☆ Relative for Steels in General
★ O—Oil W—Water
A—Air B—Brine
L—Molten (Liquid) Bath
• Double Tempered
■ Carburized
► Core Hardness
Cold Hubbing—Low C-Fe-100%
V Heat Treat, Then Nitride at 950 F. Gas Nitriding, 40-50 Hours Will Produce .012-.015" Case
Data Sheets Are Available On Each Tool Steel Grade
GRADE
AIRDI 150
WEAR RESISTANCE

Here's how it works:

To use the Selector, all you need know is the characteristics that come with the job: type and condition of material to be worked, the number of pieces to be produced, the method of working, and the condition of the equipment to be used.

FOUR STEPS— and you've got the *right* answer!

1. Move arrow to major class covering application
2. Select sub-group which best fits application
3. Note major tool characteristics (under arrow) and other characteristics in cut-outs for each grade in sub-group
4. Select tool steel indicated

That's all there is to it!

Here's an example:

Application—Deep drawing die for steel

Major Class—Metal Forming—Cold

Sub-Group—Special Purpose

Tool Characteristics—Wear Resistance

Tool Steel—Airdi 150

One turn of the dial does it!
And you're sure you're right!!

to select tool steels

Get the right answer instantly

The CRUCIBLE TOOL STEEL SELECTOR uses the only *logical* method to select the *right tool steel right from the start!* Your own experience tells you that the *application* should dictate the choice of the tool steel... and Crucible has applied 50 years of tool steel leadership to adapt this idea to the simplest, handiest instrument you've ever used—the Crucible Tool Steel Selector. Put an end to costly trial and error tool steel selection. When you're tooling up, a turn of the Selector gives you the *right answer*—instantly.

Satisfactory in every case

Now you can start with the application, and the answer you get from the Selector will prove satisfactory in every case, for the Crucible Tool Steel Selector covers 22 Tool Steels which fit 98% of all Tool Steel applications. You no longer need to start with a steel of known characteristics and back your judgment with a costly trial experiment.

And here's an important production point! ALL the tool steels on the Crucible Tool Steel Selector are in warehouse stock . . . that means when you get the answer, you can get the steel . . . fast!

Send for your selector today

You'll want the CRUCIBLE TOOL STEEL SELECTOR . . . and we want you to have it! Remember—nothing you've seen before approaches your tool steel problems so simply and logically!

mail this now

Crucible Steel Company of America
Dept. IS, Chrysler Building
New York 17, N. Y.

Gentlemen:

Sure! I want my CRUCIBLE TOOL STEEL SELECTOR!

Name_____ **Title**_____

Company_____

Street_____

City_____ **State**_____

CRUCIBLE first name in special purpose steels

TOOL STEELS

fifty years of Fine steelmaking

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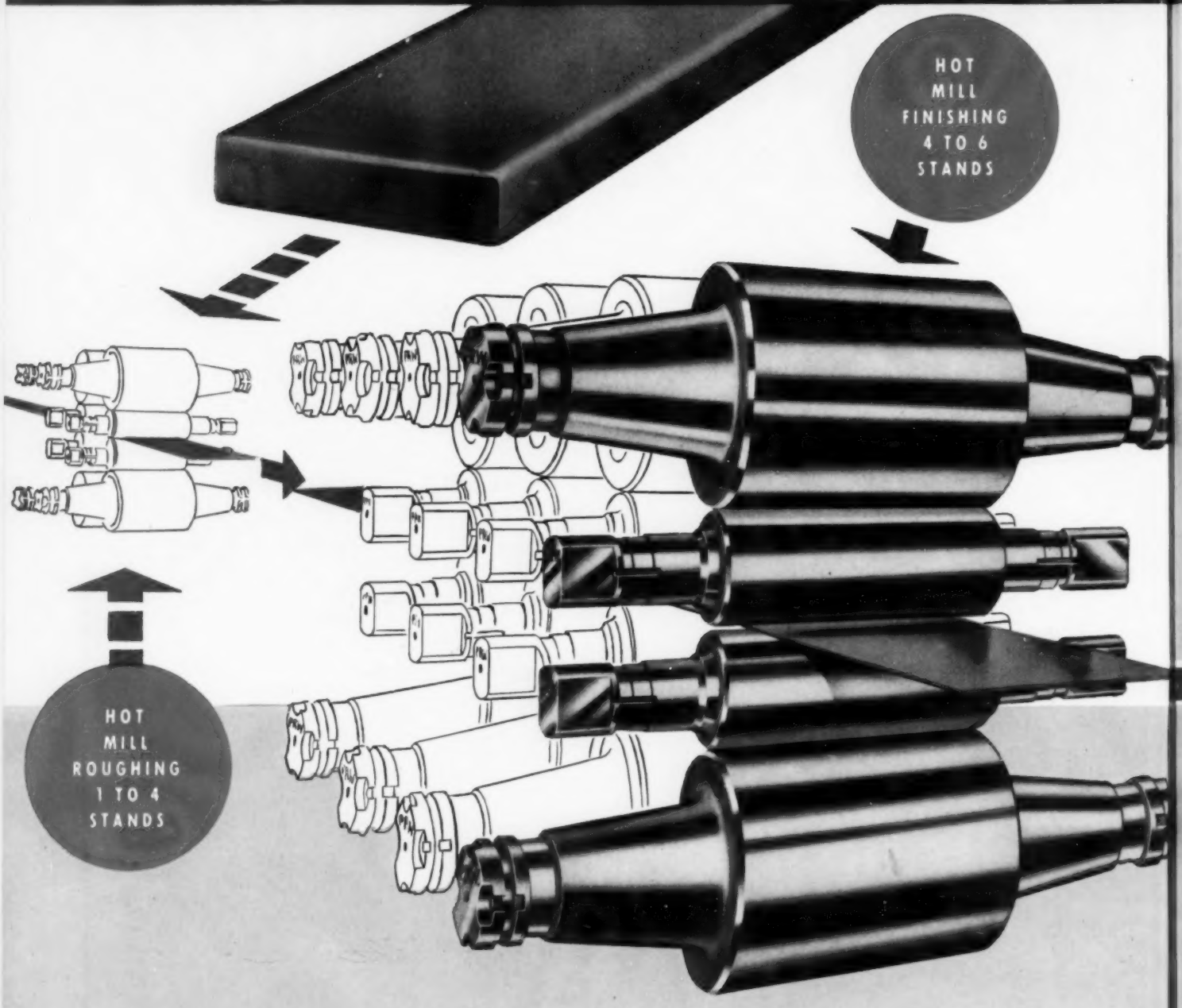
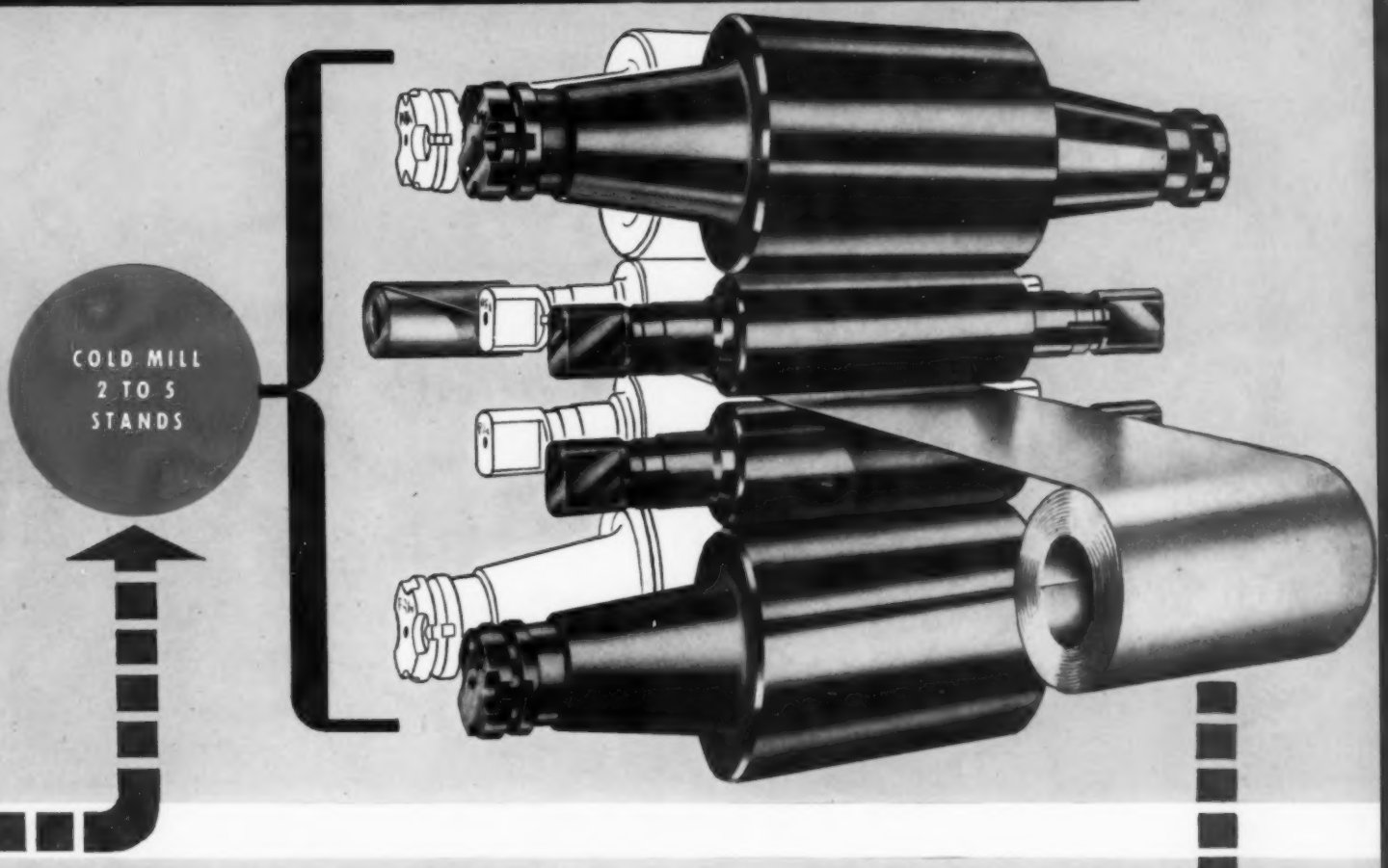
Technique for Rolling Strip

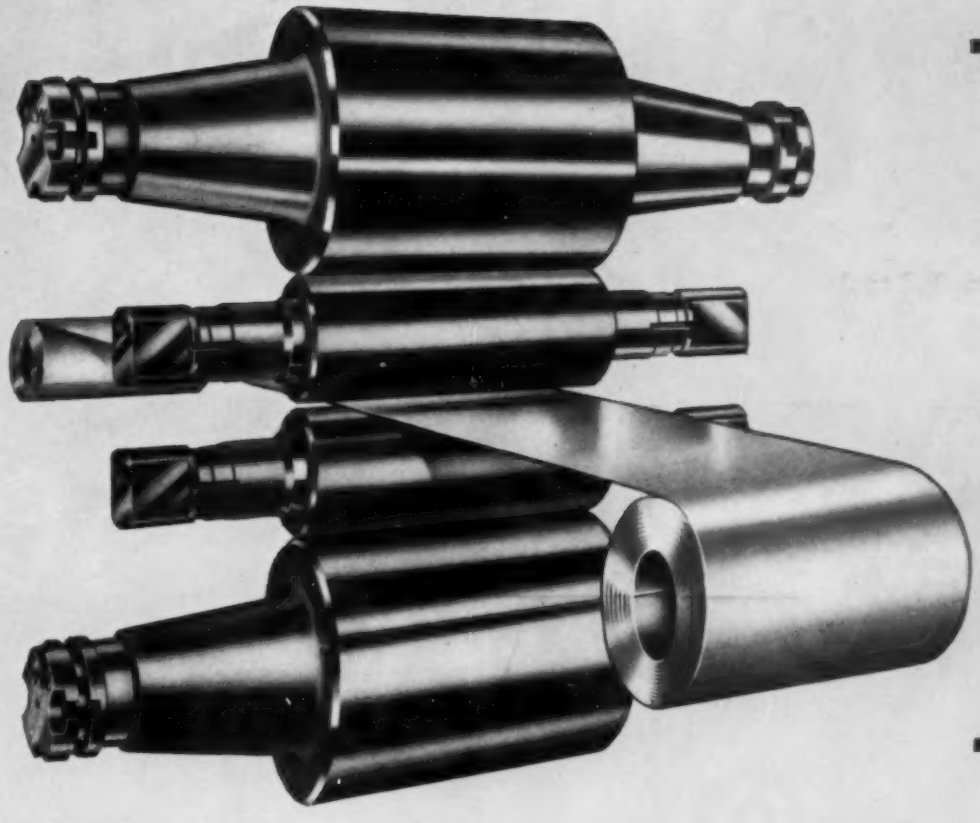


Pittsburgh Grade alloy iron work rolls and Phoenix "A" alloy steel back-up rolls in four high strip mills produce highest tonnages at *less cost per ton of steel rolled.*

PITTSBURGH

Hot and Cold . . .





ROLLS

DIVISION OF BLAW-KNOX CO.

PITTSBURGH 1, PENNSYLVANIA

all-electric 54" continuous annealing and galvanizing line —boosts output of uniform-quality heavy gage steel!

General Electric engineered furnace and drive handles gages up to .125 thick . . . speeds as high as 120 fpm . . . for a 13-tons-per-hour capacity!

Here's a case where General Electric engineered both the annealing furnace and the line drives for a new 54" continuous annealing and galvanizing line to process heavy-gage strip in a large Pennsylvania steel mill.

Handling gages up to .125 thick, the line employs amplidyne regulators and photo-electric loop controls to synchronize the strip speed and tension with furnace requirements and give smooth, rapid acceleration and deceleration from 8 to 120 fpm.

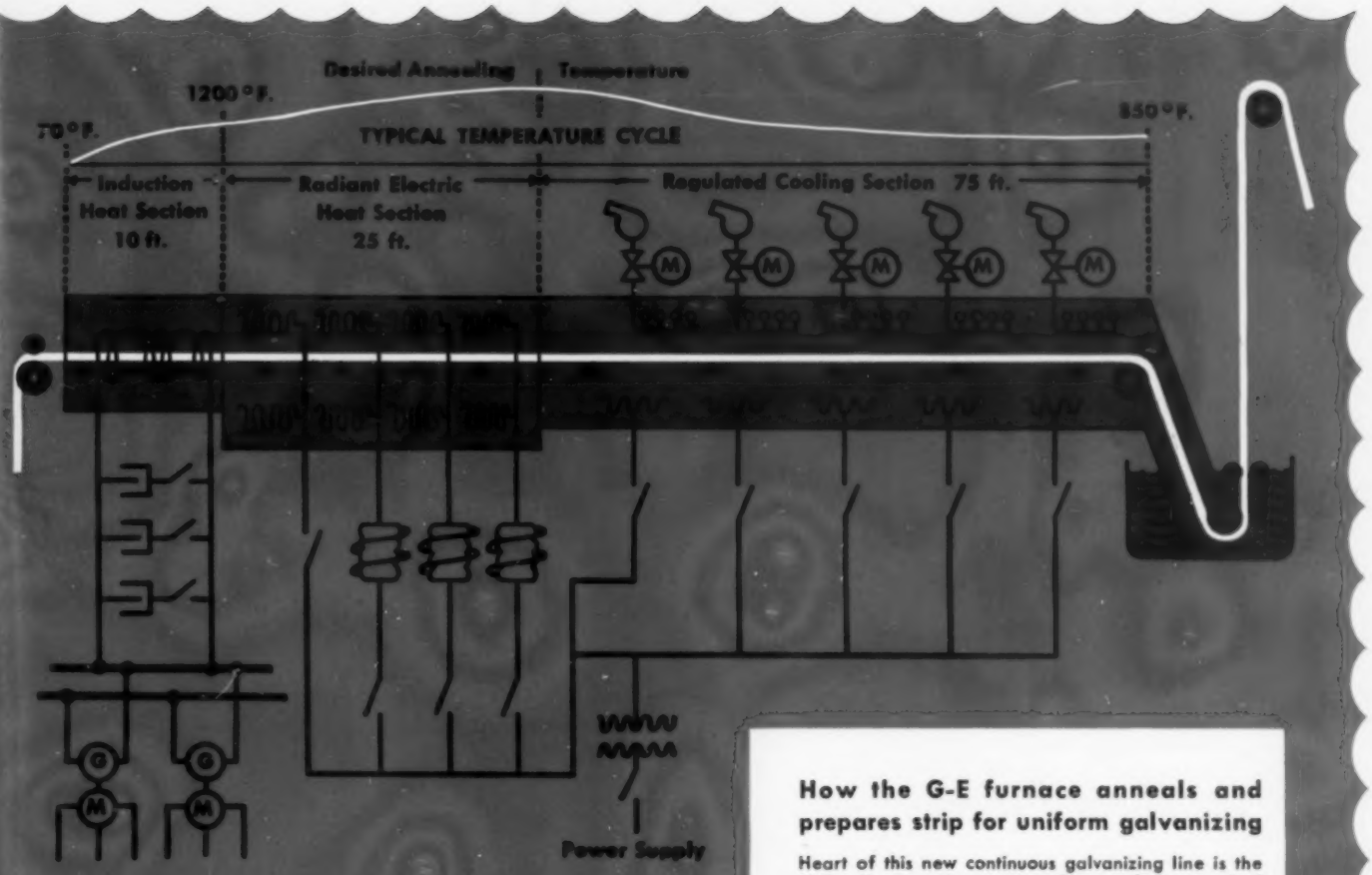
With the G-E roller-hearth electric furnace, the mill operators are assured of

- Accurately regulated temperatures which provide close control over the finished sheet's hardness and drawability
- Close control of the furnace's protective atmosphere, which eliminates the necessity of additional pickling to clean the strip
- Surface preparation that makes possible a uniformly-thick, tightly-adhering zinc coating which improves corrosion resistance and permits relatively deep drawing
- Continuous annealing process that permits greater output than with former batch methods

Whatever the right solution to your steel mill problem, you'll find it faster, easier, and at less cost when a G-E steel-mill specialist teams up with your technical staff. Call him at your nearest G-E office, listed in your classified phone directory. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

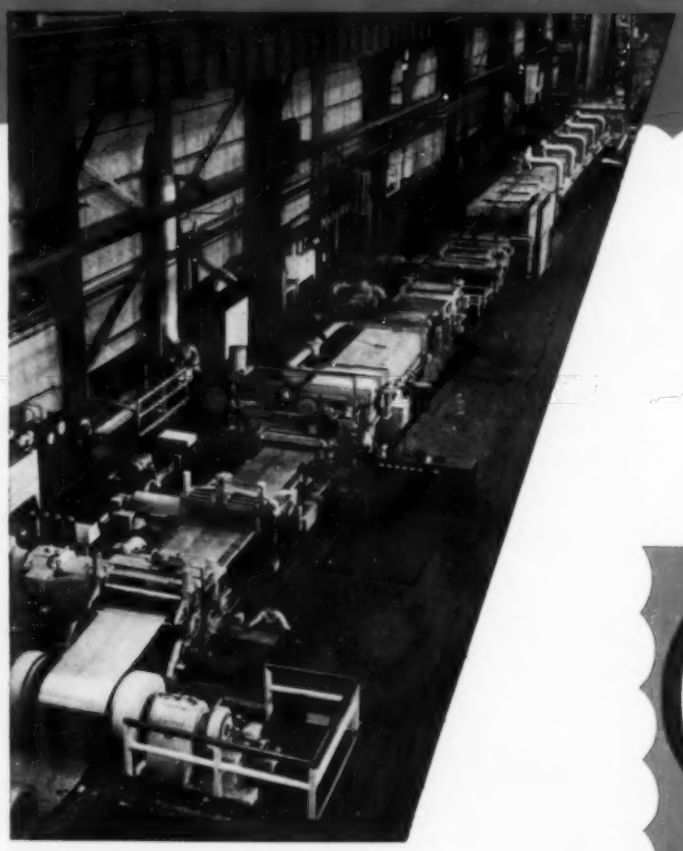
659-72



How the G-E furnace anneals and prepares strip for uniform galvanizing

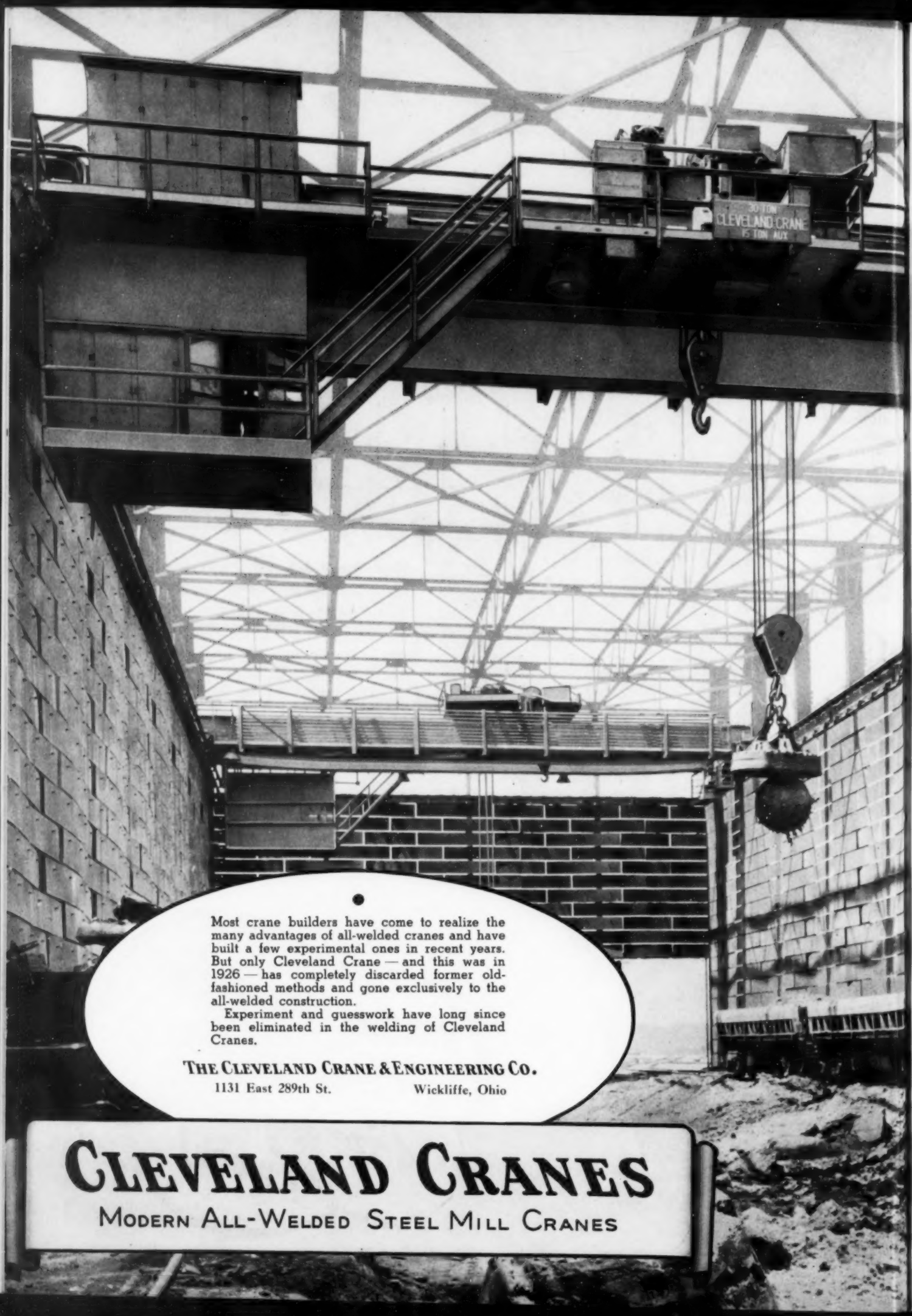
Heart of this new continuous galvanizing line is the G-E roller-hearth annealing furnace (just ahead of the galvanizing pot), which can handle steel strip from .05″ to .125″ thick and from 24″ to 54″ wide. Furnace length is considerably reduced by a 10-foot induction heating section, which uses 1400 kva of 9600-cycle power to heat the strip to 1200 degrees F. For further heating to annealing temperature, the strip enters a 375-kw, 25-foot electric furnace, most of which is automatically regulated by G-E Reactrol control. The strip then undergoes regulated cooling to 850 degrees F in a 75-foot cooling chamber.

During heating, the strip is exposed to a highly-reducing protective atmosphere that prepares its surface for galvanizing. Once prepared, the steel is further safeguarded, until it is zinc-coated, by a protective atmosphere in the cooling chamber. The furnace and its control provide great flexibility in control of temperature and of rate and degree of cooling, plus accurate regulation of the protective atmosphere.



G-E roller-hearth electric furnace (far end), plays big part in continuous wide-strip galvanizing on this 500-foot line. Its fast-acting induction preheating section speeds up heating, saves space in the line.

another example of GENERAL ELECTRIC drive engineering at work!



Most crane builders have come to realize the many advantages of all-welded cranes and have built a few experimental ones in recent years. But only Cleveland Crane — and this was in 1926 — has completely discarded former old-fashioned methods and gone exclusively to the all-welded construction.

Experiment and guesswork have long since been eliminated in the welding of Cleveland Cranes.

THE CLEVELAND CRANE & ENGINEERING CO.

1131 East 289th St. Wickliffe, Ohio

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops *and* Shorts

THE SOMEWHAT altered appearance of this issue of IRON AND STEEL ENGINEER is not the result of a planned change of format, but is occasioned by conditions beyond our control. As a result of a strike of five individuals, none of whom worked on this publication nor in a line of work used on this publication, it has been necessary to change printers on short notice. The April issue of IRON AND STEEL ENGINEER, almost completed when the trouble occurred, was unfortunately delayed.

We have always been glad that we served the iron and steel industry, and under present conditions, this feeling is increased, as we know our difficulties will have an understanding, sympathetic audience.

▲

OF COURSE, we know it doesn't apply to our own staff, but a correspondent defines a stenographer as a person to whom one dictates grammatical errors and from whom one receives spelling errors.

▲

STEEL producers, somewhat pessimistic as to their prospects some months ago, have turned optimistic in recent reports to their stockholders. Ben Moreell sees Jones and Laughlin averaging 100 per cent of rated capacity for the balance of the year. Inland's outlook, according to C. B. Randall, is for capacity operations well into the third quarter, and most encouraging beyond that. Eugene Grace says Bethlehem should enjoy full operation through the third quarter, but makes no prediction beyond that. Irving S. Olds sees U. S. Steel operations strong through the second quarter, but gradually declining during the last half, while Allegheny-Ludlum is operating at capacity and receiving more orders than it can accept, according to H. G. Batcheler.

▲

WE SEE from the papers that President Truman is now taking credit for our business conditions and prosperity. The trouble with his prosperity is that it is becoming harder and harder to afford it.

▲

LEADING off several days of testimony by steel industry officials before Representative Celler's house judiciary committee, B. F. Fairless said: "You cannot add to the stature of a dwarf by cutting off the legs of a gaint," and that just about keynotes the thinking of some of the recent investigators. These investigations have had little of the scientific approach, but have largely taken the form of inquisitions in a circus atmosphere, with all the dodges of cross-questioning, designed to irritate and to bring up anything that might be embarrassing, whether or not it has any bearing on the subject and whether or not it is true. Add to this reams of advance publicity charging those to be investigated with all the crimes in the calendar, plus an advance judgment of guilt, and what kind of results can be expected?

Let it suffice to remember that the same steel companies now under investigation as being too big were not long ago castigated for not wanting to expand.

▲

THEY SAY that mankind developed speech as a result of thinking. And now, so many speak as a substitute for thinking.

▲

WE'VE RUN across a story about a newspaper subscriber who wrote to Mark Twain, then editor of the paper, complaining he had found a spider in his paper. Twain replied: "The spider was merely looking over the paper to see which merchant was not advertising, so that he could go to that store, spin a web across the door, and lead a life of undisturbed peace ever afterward."

▲

FOLLOWING the idea that "if free enterprise dies, it will be because people don't understand it," various companies have been trying to teach their employees the value of the free enterprise system. Some managements have held lecture courses on company time "to teach people who are uninstructed in economics and to educate people who have been badly misinformed."

In some cases, union reaction to these economic educational programs has been definitely unfavorable. A CIO publication called an Allis-Chalmers lecture program a "fascist front," and the autoworkers filed unfair labor practice charges because employees had no choice but to attend the lectures and listen to management's views. That sounds as if unions don't want their members to know about free enterprise or about their company's activities.

▲

THE HOUSE organ Kreolite News calls marriage "love parsonified." But an English author, Ian Hay, says marriage is a horrible public confession of a strictly private intention.

▲

ANOTHER English author, Jerome K. Jerome, says: "I like work; it fascinates me. I can sit and look at it for hours. I love to keep it by me. The idea of getting rid of it nearly breaks my heart."

▲

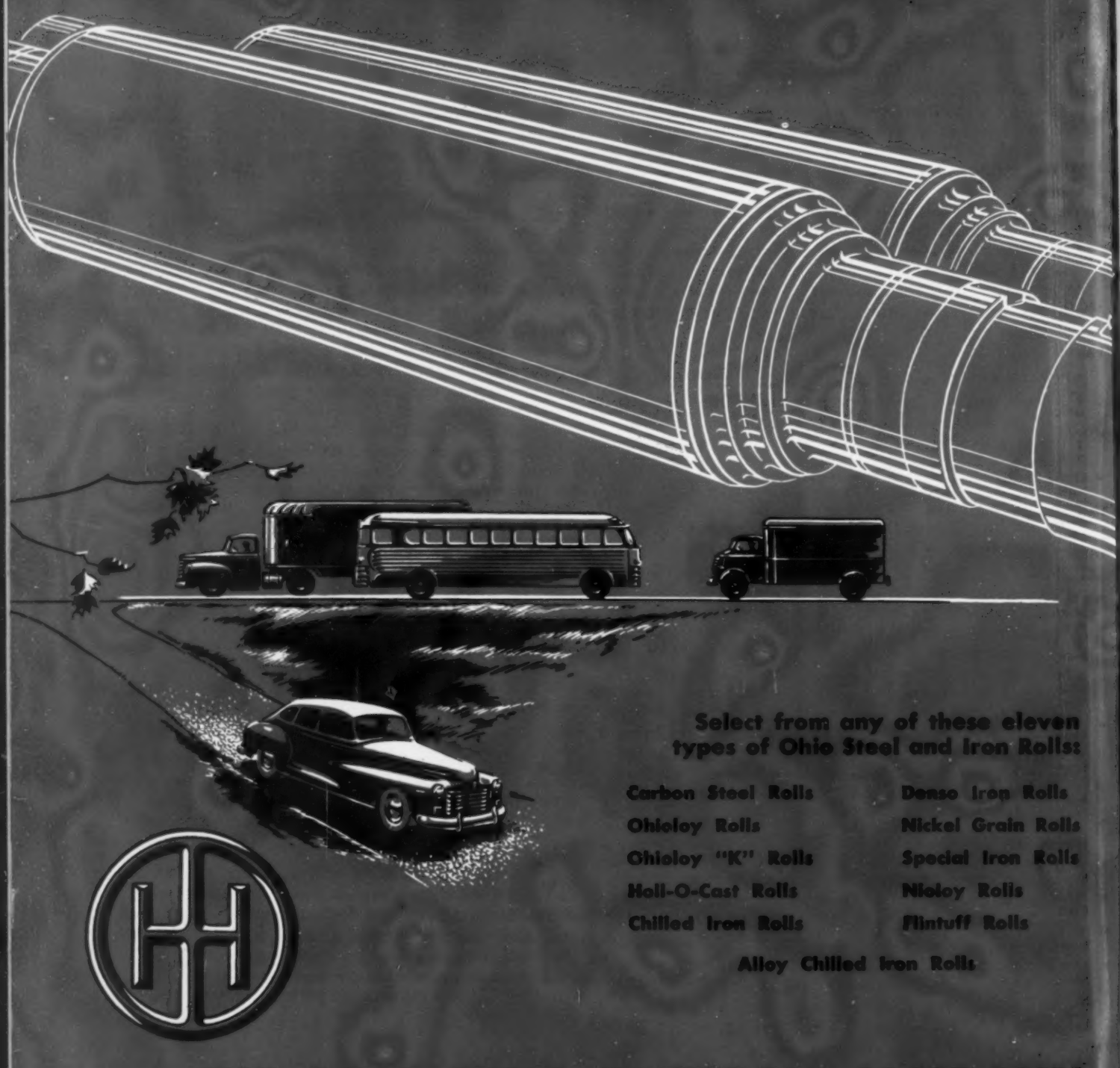
MANY writers have claimed that all great accomplishments in science and art have come from men. However, Professor W. Trinks used to say that progress was the result of the desire to live beyond income. And now we hear that the average woman is one who is always a wish ahead of her budget. If you remember your logic, you can figure from there on.

▲

SOMEONE has defined a congressman as a fellow who, when he says he's for economy, means in your district—not his.

Shaping Metal for all Industry

Ohio Rolls



Select from any of these eleven types of Ohio Steel and Iron Rolls:

Carbon Steel Rolls	Denso Iron Rolls
Ohioloy Rolls	Nickel Grain Rolls
Ohioloy "K" Rolls	Special Iron Rolls
Hoff-O-Cast Rolls	Nioloy Rolls
Chilled Iron Rolls	Flintuff Rolls

Alloy Chilled Iron Rolls

THE OHIO STEEL FOUNDRY COMPANY

LIMA, OHIO • Plants at Lima and Springfield, Ohio

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I. E. MADSEN, *Associate Editor*
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Iron AND Steel ENGINEER

MAY, 1950 VOLUME XXVII, NUMBER V

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Published Monthly by
ASSOCIATION OF IRON AND STEEL ENGINEERS
1010 EMPIRE BUILDING
PITTSBURGH 22, PENNSYLVANIA

Statements and opinions given in articles and papers appearing in "Iron and Steel Engineer" are the expression of contributors, for which the Association of Iron and Steel Engineers assumes no responsibility.

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Indexed by Engineering Index and by Industrial Arts Index.

Single Copy Foreign Prepaid $2.00 Single Copy $1.50
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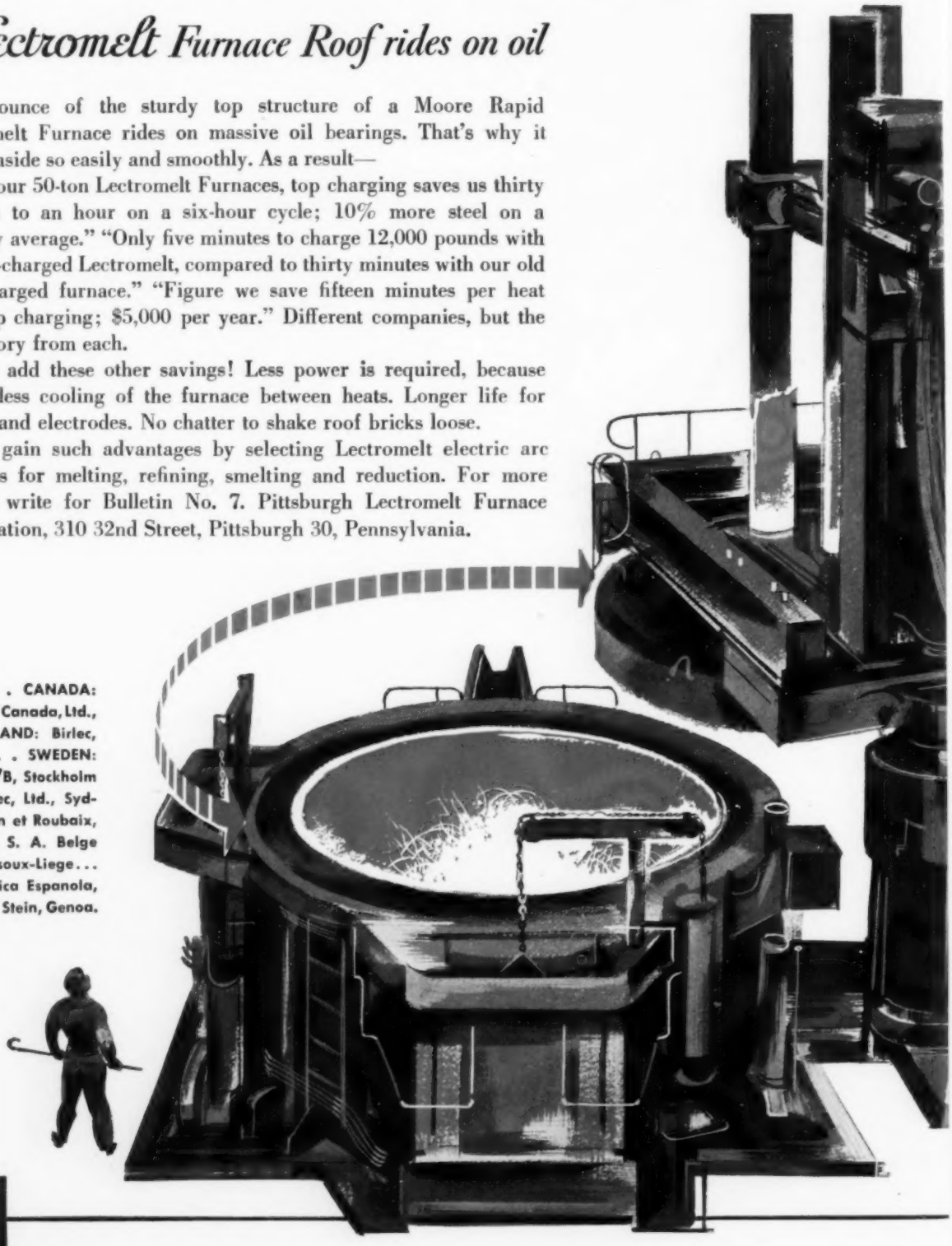

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MATERIALS HANDLING IN A STEEL PLANT

. . . . effective savings can be attained in steel plant production costs through efficient use of materials handling methods . . . .

By L. R. ASTIE
Planning Engineer
Maintenance Department
Jones & Laughlin Steel Corp.
Pittsburgh, Pa.

▲ THE production of steel has been defined as materials in motion. There are two motions involved—processing motions and handling motions. Processing motions add value to the product; handling motions add cost. In discussing the subject of materials handling in a steel plant we are primarily interested in the handling motions.

It has been said on good authority that in the average steel plant about 40 per cent of all labor on the payroll is involved directly or indirectly in the handling of materials. Also, it is said that about one-third of the total cost of production in a steel plant is involved in materials handling. Safety authorities tell us that about 70 per cent of all personal injuries in a steel plant are due to some phase of materials handling.

Therefore, materials handling in a steel plant is a timely and important subject to discuss at any time, but it is especially important at a time such as the present when one of the chief interests of steel plant management is in the reduction of production costs.

During the past fifteen years much has been accomplished in the improvement of materials handling methods in steel plants. However, it is hoped that a general review of the problems involved and perhaps a fresh viewpoint of the entire operation will initiate further improvements; which should result in lower production costs and improved working conditions in every department of the plants.

The purpose of this paper is not to discuss the details of any specific materials handling methods or improvements, but rather to review some of the general problems and accomplishments in the handling of materials which should aid in establishing a goal toward still greater achievements in the future.

IMPORTANCE OF MATERIALS HANDLING IN THE PRODUCTION OF STEEL

In the manufacture of steel, materials handling starts before production begins; it starts with the construction, maintenance and servicing of the plant facilities and equipment necessary for steel production. Then it follows in the receiving, storing, and movement of materials to and from the various stages of production and work performance until the finished product is finally processed or the job completed to meet the customer's requirements.

Materials handling also continues after production ends, that is, until the finished product reaches the customer. Finished steel must be bundled, packaged, palletized, or loaded in lifts, in a form to meet the customer's handling requirements. Likewise in plant maintenance, construction, and service work, materials handling continues until a job is cleaned up and excess materials are returned to storage for future use.

In endeavoring to obtain urgently needed production during World War II, and in attempting to meet the abnormal demands for steel during the post-war period, steel plant supervision became increasingly aware of the importance of improved and mechanized handling equipment as an aid to increase production and to overcome the shortage of labor. This awareness will, no doubt, continue to increase in the future because of the constant effort that will be necessary to overcome the tendency of steadily rising production costs.

To improve materials handling methods the changes

Figure 1 — Some of the heaviest loads lifted by the materials handling equipment in a steel plant occurs in ingot handling.

Figure 2 — Bricks shown are being delivered for an open hearth furnace rebuild.

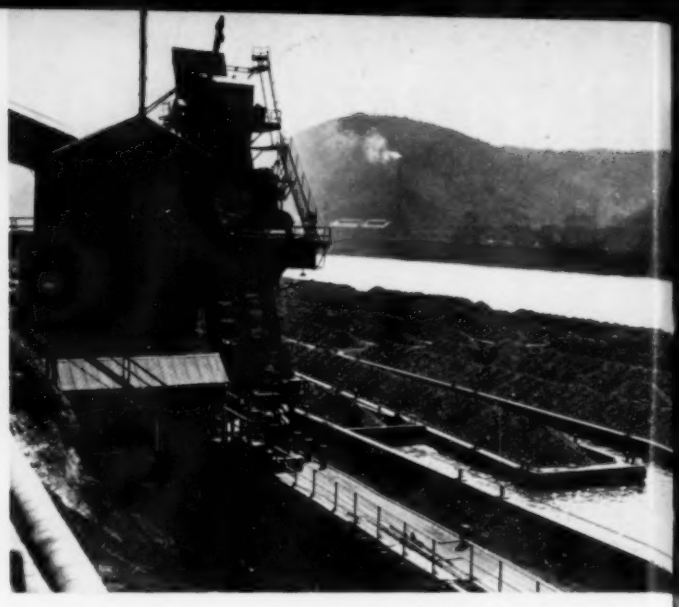


Figure 3 — Large tonnages of coal and ore must be delivered to the steel plant. These may come both by water and by rail.

need not always be pronounced or outstanding. Some of the most simple improvements have resulted in the elimination of hard and strenuous work, and made very substantial savings in production costs. It is now becoming a matter of common knowledge that by simple mechanization, materials handling operations have been simplified, the flow of material has been increased in volume, production made more uniform, worker fatigue minimized, personal injuries materially reduced, productivity per man hour increased, and production costs generally reduced or kept in line in the face of increasing prices.

Therefore, the period has been reached in steel plant operation when it is important to have a proper organizational setup to know and keep a continual check of material handling costs and handling methods, with the constant objective of developing further improvements which will ultimately result in lowered production costs and better working conditions.

Due to the nature of steel plant operations, the overall job of materials handling is a big one, because materials handling cannot be considered as a separate and distinct phase of steel production. It is an integral part of every phase of steel plant construction, plant maintenance, and plant operations.

MAGNITUDE OF MATERIALS HANDLING IN A STEEL PLANT

That the operation of a steel plant is a huge job of materials handling is a matter of common knowledge. However, most of the plant operators are not always conscious of the various tonnages of specific materials handled to complete the cycle of steel production. To complete the cycle of production in the average steel plant, the American Iron and Steel Institute has shown that it is necessary to handle between 60 and 70 tons of materials for each ton of steel shipped. In other words, for each car load of steel shipped, between 60 and 70 car loads of materials are handled. That is approximately the equivalent of a train load of materials handled for each car load that is shipped.

For a specific example of the various materials handled in the production of finished steel, let us review the intra-plant freight movements at the Pittsburgh Works of the Jones & Laughlin Steel Corporation for one month in which about 127,000 tons of finished steel was moved over the plant railroad system. These tonnages were as given in Table I:

TABLE I
INTRA-PLANT MOVEMENTS

	Tonnage net tons
1. Coal	270,958
2. Coke	137,976
3. Ore, sinter, flue dust	286,760
4. Limestone	80,393
5. Hot metal iron	326,352
6. Slag	117,580
7. Scrap	203,977
8. Ingots	180,827
9. Blooms, slabs and billets	271,931
10. Semi-finished product	30,383
11. Finished product	127,207
12. All other materials	287,126
Grand total	2,321,470

These figures show that about 17.2 tons of rail freight were moved within the plant for each ton of finished steel that was moved. By using a very conservative estimate of an average of four handlings for each ton of freight moved, more than 9¼ million tons of material were handled for the month or about 73 tons for each ton of finished steel moved. However, there are many items such as cold drawn steel, strip and tin plate products, in which material is handled more than 20 times before it is finally shipped.

To perform this task of material handling, a greater variety of handling methods and equipment are used than in any other industry in existence today. Much of the machinery such as overhead cranes, transfer tables, heavy duty conveyors, ladles and other heavy handling equipment is of a special nature and de-

Figure 4 — A scraper attached to the end of a charging machine peel enables the removal of debris from the open hearth with a minimum of hot and hard labor.

Figure 5 — The high lift crawler type tractor is effective in cleaning out the debris from the port end of an open hearth furnace.

signed for some specific job of handling. Development and application of this type of equipment is a specialized job. It is usually well engineered and improvements are followed up by manufacturers of the equipment. Engineering specialists and the respective operators of the equipment also contribute with their knowledge and experience toward its further development. Metal trade journals, and engineering associations through periodicals, meetings and conferences generally follow these developments and furnish an endless stream of information which is available to those who are interested. Therefore, by the exchange of information and comparisons of performance, improvements in the specialized material handling equipment is generally well covered by the respective departments of the plants.

Many types of standard equipment such as lift trucks, fork trucks, portable conveyors, truck cranes, locomotive cranes, and pallet systems are purchased from manufacturers of standard material handling equipment who supply the steel plants with equipment that is used by many other industries as well as steel plants. The sales engineers representing the manufacturers of this type of equipment spend about 90 per cent of their time in attempting to educate the prospective users of their respective equipment as to its possible or probable applications. Success of their efforts is dependent upon their contacts in the plants and many other variables; such as experience of the manufacturer's representative, interest of the operating people, ingenuity of those concerned in possible alterations to the equipment or changes in production methods to enable the successful adoption of the equipment.

To learn and develop all the possible uses of these standard items of material handling equipment is usually a task beyond the practical experience and time limitations of the manufacturer's engineers and field representatives.

The trade magazines and other media of trade information are filled with advertisements and excellent descriptive articles on successful applications and probable uses of an endless number of these time and labor-aiding items. However, due to the many other time-consuming duties and the limited time available to read and properly digest this increasing flow of literature by those who receive it in steel plants, it is possible that some of the steel plants are not availing themselves of the benefits from the maximum practical use of modern handling equipment and methods applicable to their respective operations.

The selection of the most suitable equipment for the job, in most cases, is a very complex problem because of the increasing variety of handling equipment that is now available and the diversity of possible operating setups which can be made to perform a required job of materials handling.

It has been found by both the manufacturers and users of this equipment that careful preliminary planning, taking into consideration such factors as physical condition of buildings, cost of equipment, cost to adopt the use of the equipment, probable maintenance costs, and a thorough investigation of recommended handling methods and type of equipment, is necessary for the successful selection and proper application of the equipment. Therefore, the industrial engineering departments of steel plants are

Figure 6 — The truck shown is a self-loading and unloading unit.

Figure 7 — By mounting the 10-ton, one man boom crane on pneumatic tires, it can be used anywhere in the plant.

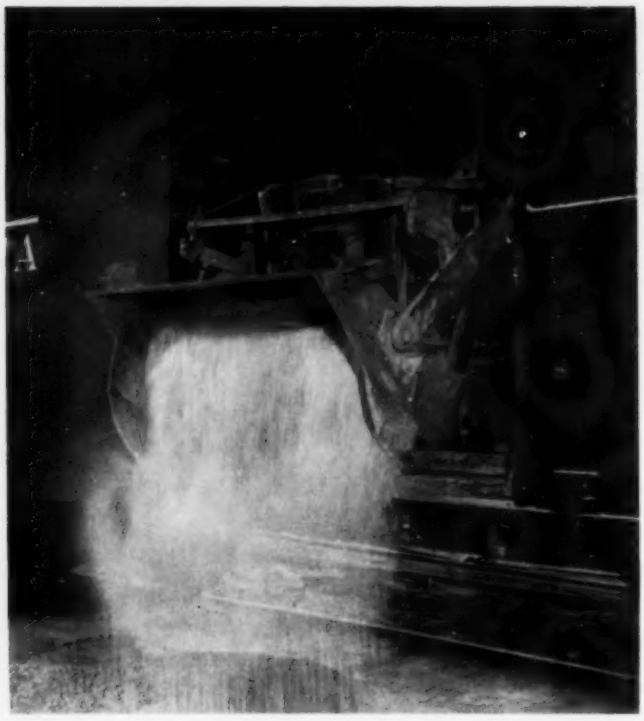


Figure 9 — The car scoop is shown unloading bulk material from the box car.

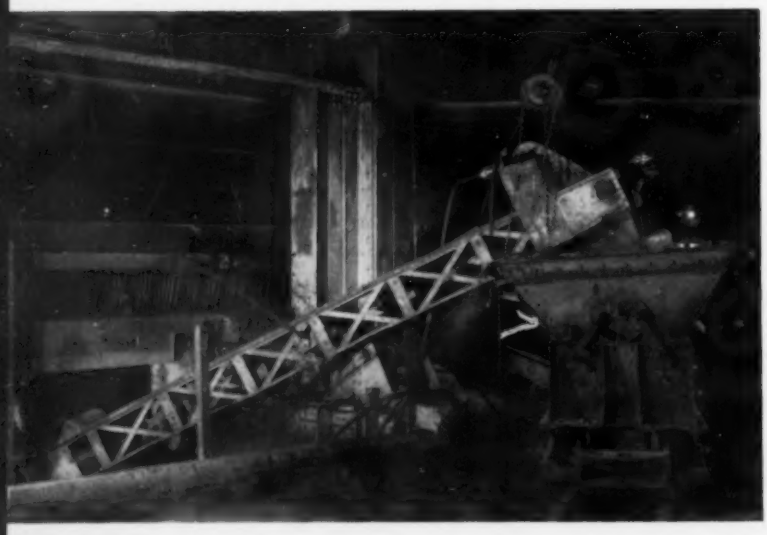
continually burdened with problems of studies for determining improved flow of materials to justify the use of various types of suggested equipment.

NEED FOR SYSTEMATIC STUDY OF MATERIAL HANDLING METHODS

Due to the increasing variety of methods and equipment available to perform the job of materials handling, the users as well as the manufacturers have become aware of the need for an organized approach to the study of the equipment and economies of the handling methods involved.

It is realized that standardization in construction and parts of the equipment, as well as probable standardization of methods, can result in worthwhile savings in initial cost of equipment, maintenance costs, operating costs and time saved in handling materials. A number of group activities have been started in recent years with existing trade associations, professional societies and engineering schools to follow various general and specialized phases of materials handling engineering. Also some new organizations or collective groups have been started, and a number of industries have established the positions of materials handling engineers or materials handling supervisors.

Figure 8 — The portable conveyor with an air motor drive can be very effectively used in many steel plant applications.



REVIEW OF IMPROVED METHODS

The attack on the problem of improving materials handling methods along with the improvement of technological and processing methods in steel plants has been going on for many years. However, during the past ten or fifteen years many effective and ingenious independent developments of improved materials handling methods, together with revised plant layouts, have been worked out quite successfully. Such improvements as the use of palletization and fork trucks for the handling of brick and many other materials; high lift crawler type tractors for open hearth furnace dismantling, pit and yard cleanup, and a gradually increasing number of other jobs; self-loading and unloading truck units, which pick up or set off as much as 8-ton loads in 4 to 8 cubic yard containers; boom cranes on pneumatic tires, which overcome the limitations of track or caterpillar type cranes; various types of portable conveyors which have materially reduced the need of rehandling bulk and other materials—all these and many other items too

numerous to mention at this time have contributed not only toward making physical labor lighter, but also in reducing costs and personal injuries.

These improvements in materials handling methods also have resulted in increased availability of production and storage space by permitting the higher piling of material as well as the more rapid movement of material in larger quantities.

A list of some of the specific improved materials handling methods adopted at the Pittsburgh Works of Jones and Laughlin Steel Corporation will serve as an example of what has been done throughout the industry to a greater or less degree during the past ten years in an effort to improve working conditions, overcome the shortage of labor and to maintain a higher production level. The following list is not intended to be complete:

1. Power scoop to unload bulk materials from box cars.
2. Crawler type high lift tractors for furnace dismantling, construction work, miscellaneous maintenance and plant cleanup.

Figure 10 — The crawler type tractor has a swing boom which is shown cleaning open hearth furnace slag pockets.

3. Open side carriers for handling ladle brick from railroad car to final consumption.
4. Storage and handling of refractory brick in open end boxes.
5. Extensive use of portable power conveyors in dismantling and rebuilding of furnaces.
6. Vacuum conveyor system for removal of open hearth flue dust and handling of boiler house ashes.
7. Shop mule or pneumatic tired tractor and trailer system for movement of interdepartment materials.
8. Self loading and unloading standard truck unit which handles 4 to 8 cubic yard containers.

Figure 11 — Brick can be handled in open side carriers.

9. Ore car unloading cranes at the blast furnace stock house.
10. Use of grab bucket to load limestone into charging boxes.

Figure 12 — Refractory brick can be stored effectively in open end boxes.

Figure 13 — The boxes are used to handle the brick to the job site.

Figure 14 — A shop mule can be used to handle small materials to points which are inaccessible to ordinary trucks.

Figure 15 — The ore car unloader scoop pushes the material through the hopper door.

11. Use of larger type 50-cu ft grab buckets to handle slag at the open hearth slag dock.
12. Use of a powered bucket and conveyor type loader to load limestone and scale from bins to charging boxes at the open hearth charging floor—thus replacing hand labor.
13. More extensive use in receiving bulk commodities such as lime and dolomite in railroad container cars.
14. Scraper attachment for end of charging machine peel to scrape out open hearth furnace bodies.
15. Installation of drag line type scraper in open hearth cellar to move debris to elevator hoist thus replacing slow wheelbarrow practice.
16. Use of diesel-powered locomotive cranes.
17. Use of diesel-electric and heavier locomotives.
18. Powered wheelbarrows.
19. Vibrators for unloading coal from hopper cars.
20. Use of various types of grabs on overhead cranes.
21. Paving of roadways throughout the plant to expedite truck and tractor deliveries and reduce equipment maintenance cost. More extensive use of truck type equipment in intraplant movement of materials.
22. Boom cranes on pneumatic tires.
23. Use of dragline scraper to remove scale from under blooming mill ingot conveyors and transfers.
24. Portable air hoists used by riggers and millwrights to reduce need for special rigging setups.
25. Use of powered sweepers to reduce need for rehandling of sweepings as well as improving yard roadway maintenance.
26. Extensive installation of electric water coolers and replacement of ice coolers which required considerable labor for handling of ice.
27. Vacuum system for transportation of drillings to chemical laboratory.
28. Erection of modern truck loading dock at cold finishing mill.

In addition to this type of independent materials handling improvements, there have been many changes in sections of processing equipment and changes in operating practices which have benefited materials handling in many ways, resulted in increased production, and improved plant operating conditions. Among these items are:

1. Enlarged open hearth furnace doors.
2. Enlarged charging boxes.
3. Larger and faster charging machines.
4. Increased open hearth stock house track facilities.
5. Enlarged slag pocket doors which permit use of mechanical equipment to remove slag.
6. Enlarged checker chamber doors which permit use of conveyors and better working conditions for delivery and removal of brick.
7. Use of longer lasting refractories which extend life of furnaces between rebuilds, thus reducing the need for dismantling and rebuilding materials.

8. Increased size of ladles and ladle cranes.
9. Increased size of ingots.
10. Installation of larger stripper cranes.
11. Use of 30-ton fork trucks at strip mill.
12. Installation of pallet type conveyor for handling of coils at hot strip mill.
13. Erection of modern boiler house where 5 modern boilers replace 43 old type boilers.

ECONOMICS OF MATERIALS HANDLING

What is needed for improving materials handling methods in a steel plant is a more thorough investigation into the details of materials handling, more analysis of moves, more careful investigation for new

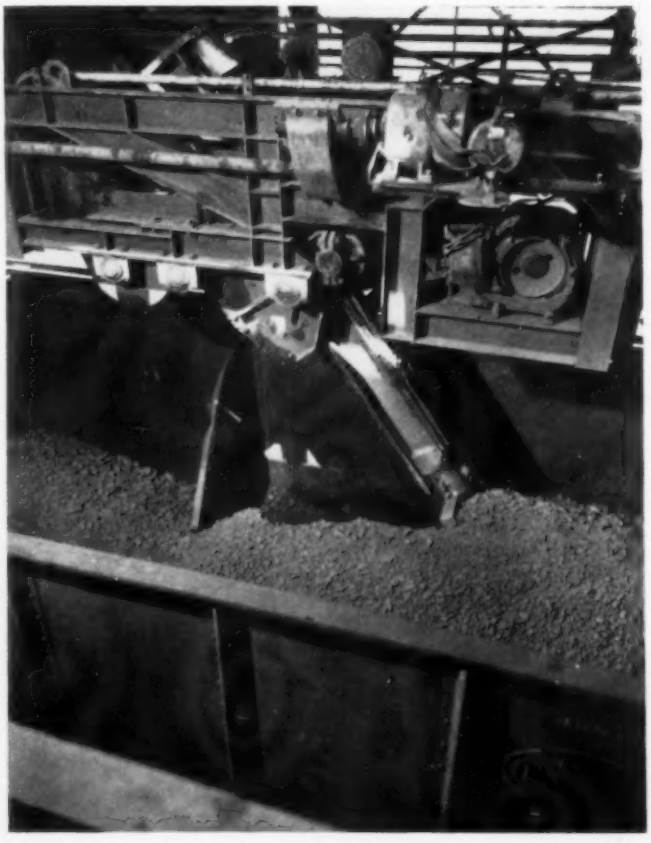


Figure 16 — The ore unloader is shown pushing the scoop into the ore to make an opening in the door.

or better methods and increased use of mechanization.

The fact must be recognized that when workmen or departments must travel long distances to obtain material, equipment, or tools and to dispose of finished product, equipment, or tools, time that should be productive is devoted to materials handling. Worker's time is lost and plant money is wasted. In the average steel plant where so much time and money is involved, this waste of time and money usually runs into large figures. For example, consider a fair sized steel plant of about 10,000 employes and consuming about 24 million man-hours per year at an average rate of $1.70 per hour.

As stated by good authority, better than 40 per cent of all labor in a steel plant is involved in some form of materials handling; hence, about 10 million

Figure 17 — The conveyor type bucket loader is loading limestone for transfer to open hearth charging boxes.

man-hours were devoted to the work of handling materials. An improvement of 10 per cent would have resulted in a savings of about one million man-hours or $1,700,000 in wages alone.

Closely allied to the cost factor is the effect which materials handling has on a plant's industrial relations and morale in general. The benefits from better materials handling methods are not always directly measurable in dollars. Good morale does not appear on the cost sheets, but in time it has been shown over and over it will have an increasingly good effect on costs.

Figure 18 — The dragline scraper is cleaning flue dust and debris from the open hearth furnace flues.

Figure 19 — The photograph shows a modern truck loading dock in the cold finishing department.

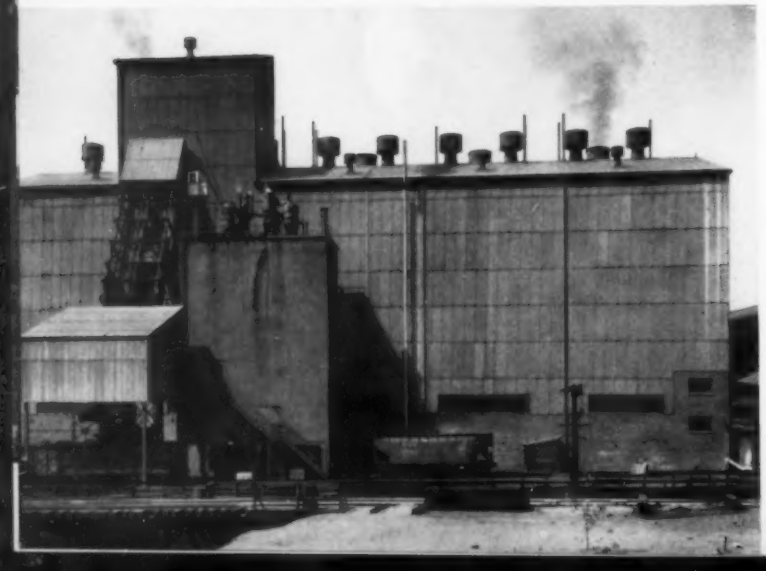
CONCLUSION

The controversial problems in steel plant layout or plant improvement these days usually are not mechanical, electrical, or metallurgical. Generally, they are materials handling and flow of materials, movement of equipment and movement of manpower.

To continue to improve in materials handling methods, operators must maintain an open-mindedness toward new ideas; and must, above all, be persistent in questioning existing methods.

In order to achieve proper results, everyone must cooperate from top to bottom. Improving materials handling is not just the job of an engineering genius or production expert. However, due to the present large scale production volume, and the increasing complexities of operating conditions, it has become necessary that there be specialized help to direct thinking and help find answers for the endless number of problems that arise in every phase of plant operations. Therefore, it is necessary to take advantage of the knowledge and opinions of those who make a study of modern materials handling methods and techniques, to help solve materials handling problems.

Figure 20 — The latest techniques in materials handling methods are used in the new boiler house.



DISCUSSION

PRESENTED BY

R. J. GEITMAN, Engineer, Link-Belt Co., Chicago, Ill.

L. R. ASTIE, Planning Engineer, Maintenance Dept., Jones & Laughlin Steel Corp., Pittsburgh, Pa.

These men may be industrial engineers, production supervisors, outside consultants or materials handling engineers. In any case, they are persons who are devoting their thinking and energies toward making the job of handling and moving materials more pleasant and at a lower cost.

R. J. Geitman: Mr. Astie has painted a broad yet vivid picture of the importance of materials handling in the economics of steel plant operation. His examples indicate many opportunities for reducing costs, improving safety conditions, and raising morale.

He has pointed out the large tonnage of materials that has to be handled to produce one ton of finished product, and recommends systematic study of materials handling methods and equipment, persistent review, and questioning of existing methods, and maintaining an open-mindedness to new ideas. As emphasized by Mr. Astie, this is a steel plant job, requiring follow-through from top to bottom; however, engineers from materials handling companies can be most helpful in such study. I am wondering if Mr. Astie can tell us if the maintenance of material handling equipment is given as much consideration as production equipment.

L. Russell Astie: I wonder if that question could not be answered better by some of the master mechanics in the audience. Materials handling equipment in a steel plant is usually considered of secondary importance. Delays due to breakdowns or inefficient operation of this equipment usually do not show up on delay sheets or production reports as in the case with production or processing units. Therefore, there is a tendency for maintenance crews to give prime consideration to the prevention of delays and breakdowns to processing units. The secondary handling equipment usually gets enough attention when it breaks down to get it going again. This situation usually exists where maintenance of all equipment comes under one head.

In plants or departments where the maintenance of materials handling equipment is the function of a separate organization, I would say that it receives the same consideration and attention that is given to the primary production units. Since there is no definite or standard organizational setup for the maintenance of materials handling equipment, it is difficult to give a clear cut yes or no answer to this question and at the same time be fair to all concerned.

Perhaps in time standards of organization for maintenance and definite maintenance policies will be adopted which will enable us to answer the question more specifically. As the maintenance setup stands at the present time, some give materials handling equipment the same consideration and others do not.

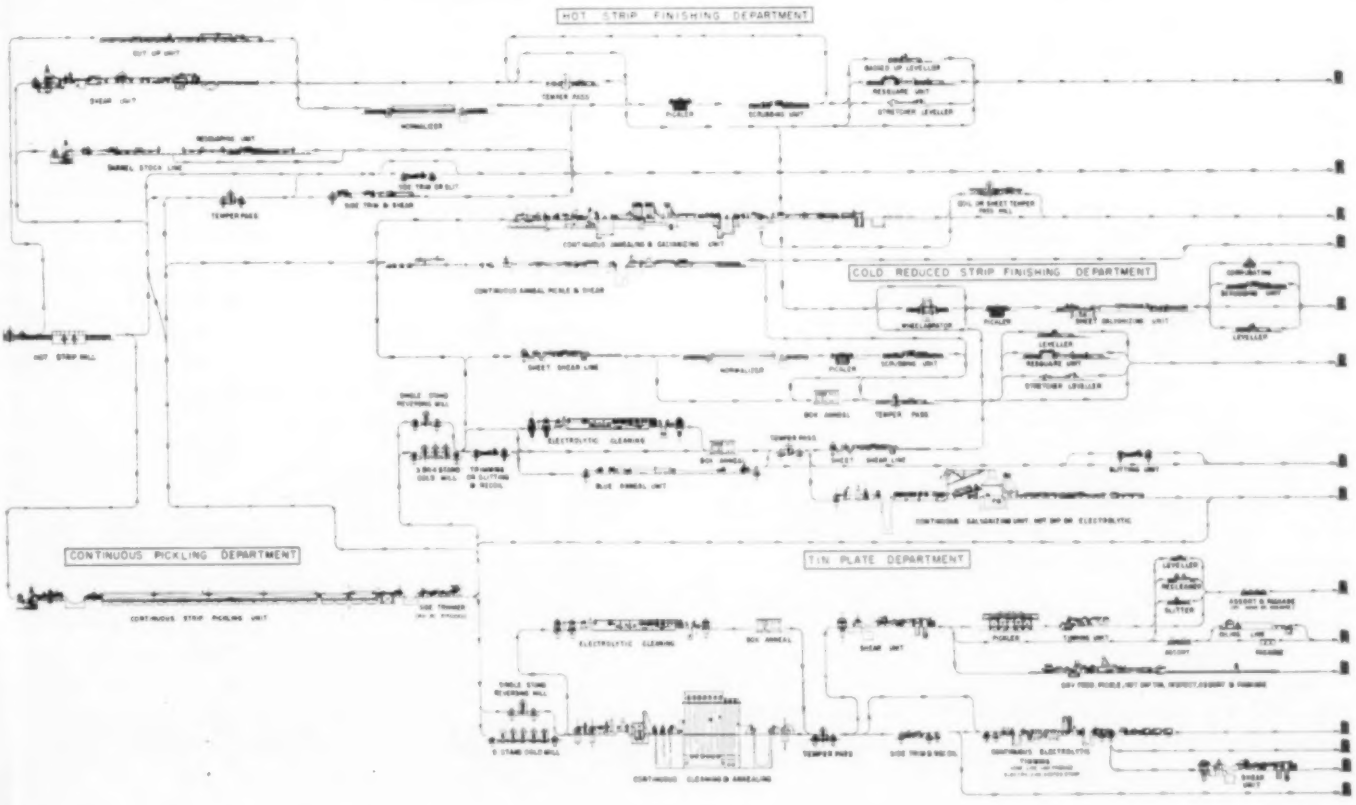
Coil Handling In The Steel Industry

By D. A. McARTHUR
Chief Engineer
The Wean Engineering Co., Inc.
Warren, Ohio

. . . . . many ingenious devices have been developed to handle coils in the steel plant . . . future improvements and developments in such equipment are directed to further reducing surface damage, and to faster and more economical handling . . . .

▲ IN gathering material for this paper, it was decided to limit it to the handling of wide coils in wide strip mills and in making the study, approximately twenty-five of the largest mills were considered. In the belief that statistical information would be of considerable interest to the engineers throughout the industry, questionnaires were sent to each of these mills asking them many questions regarding methods of handling coils, stocking coils, etc. The response to these questionnaires was gratifying and a considerable portion of this paper will be devoted to presenting the facts accumulated from the replies.

Figure 1 — This schematic diagram shows the flow of material from the hot mill through the subsequent finishing processes.



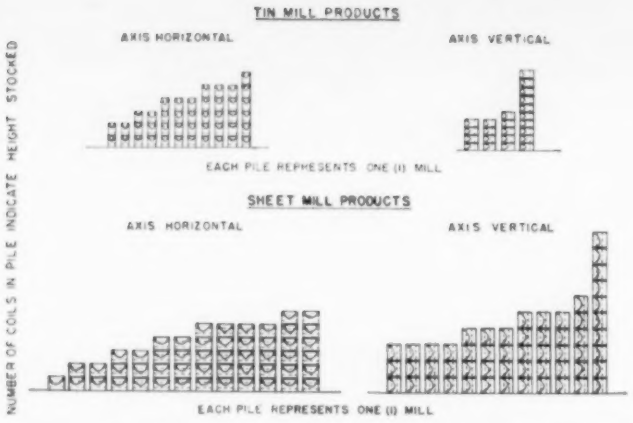
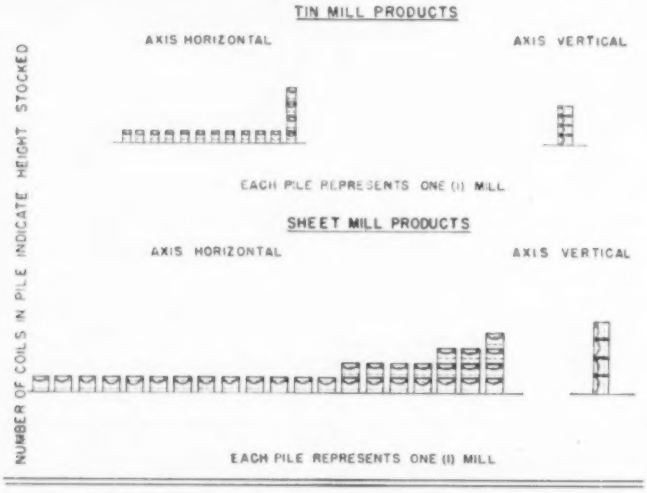


Figure 2 — Data is given on stocking hot rolled coils for sheet and tin mill products ahead of pickle line.

Figure 3 — Chart gives method of stocking hot rolled pickled coils ahead of cold mill.



In considering coil handling in such mills, it is first necessary to think of the points at which it is necessary to handle the coils. This is fairly well illustrated by Figure 1, which shows flow of material from the hot strip mill through subsequent finishing processes.

All of the lines with little arrows on this chart show places where material is handled, and at approximately half of these handling points the material is in coil form. Since the chart was made up to show the complete finishing operation, certain of the lines show handling of cut material which is not considered as a part of this particular paper.

In addition to handling between each of these operations as is illustrated on this chart, material is usually stocked, as it is practically impossible to exactly synchronize each operation with each other operation. Therefore, perhaps the most interesting thing to discuss first is the method of stocking at each point, as this in a great measure determines the methods that can be used for handling the coils to and from stock.

Based entirely upon the answers to a questionnaire, a series of charts have been prepared showing how the coils are stocked in each mill. On most of these charts the answers have been divided into two classes —tin mill products and sheet mill products. Some mills produce both types of material and some only one or the other. Therefore, the number of mills reporting in each place may vary considerably. Tin mill products, of course, refer to all coils which are normally rolled on a five-stand tandem mill to very light gages and are either tinned or shipped as tin mill black plate. Sheet mill products include everything wider than approximately 24 in. that is not tin plate.

The first point at which coils are stocked is between the hot strip mill and the pickle line. The answers to the questionnaire are illustrated in Figure 2. There is nothing particularly surprising regarding the answers which show the methods of stocking fairly evenly divided between stacking with axis horizontal and with axis vertical. In general, mills producing the lighter coils stock horizontal, and the mills producing heavier coils stock vertical. The one producer who reports that he stacks coils ten high at this point is certainly making the maximum use of his floor space. The number of mills that stack coils with axis horizontal five and six coils high no doubt explains the large number of egg-shaped coils that are fed to the entry end of pickle lines.

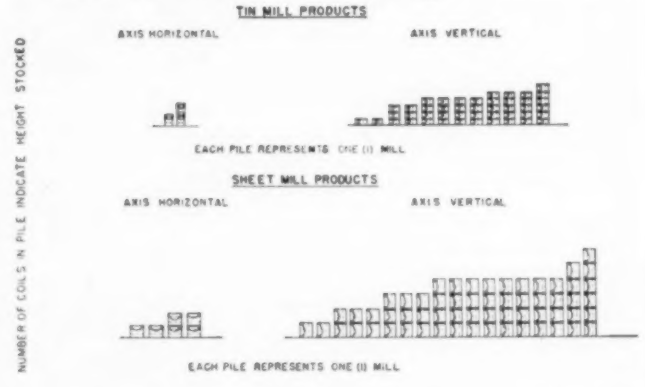
In stocking hot rolled coils ahead of shear lines for material to be cut up in hot rolled form, as might be expected almost exactly the same methods are used as for the same coils before pickling.

Figure 3 illustrates the method of stocking coils

TIN MILL PRODUCTS
AXIS HORIZONTAL
AXIS VERTICAL
NUMBER OF COILS IN PILE INDICATE HEIGHT STOCKED
EACH PILE REPRESENTS ONE (1) MILL

Figure 4 — Chart gives method of stocking cold rolled coils ahead of cleaning line.

Figure 5 — Chart gives method of stocking cold rolled coils ahead of annealing.



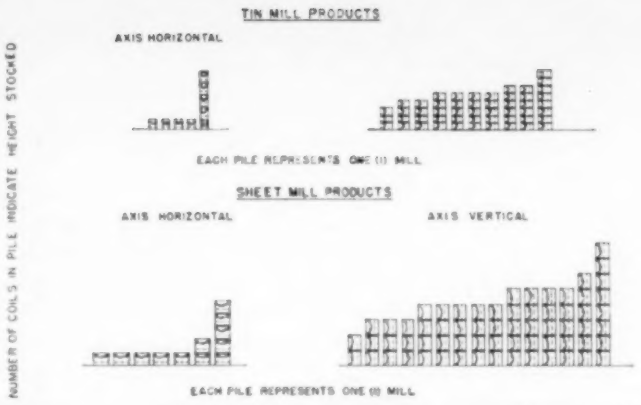
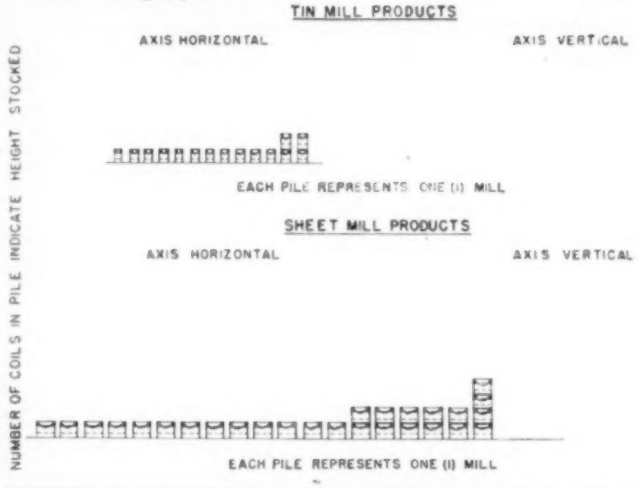

TIN MILL PRODUCTS
AXIS HORIZONTAL
EACH PILE REPRESENTS ONE (1) MILL
SHEET MILL PRODUCTS
AXIS HORIZONTAL
AXIS VERTICAL
EACH PILE REPRESENTS ONE (1) MILL
NUMBER OF COILS IN PILE INDICATE HEIGHT STOCKED

Figure 6 — Steel mill practice for stocking cold rolled coils after annealing and ahead of the temper mill is given in this graphic chart.

Figure 7 — Steel mill practice of stocking cold rolled temper passed coils ahead of shear line is given in this graph.



between the exit end of the pickler and ahead of the cold reduction mill. Here a much greater unanimity of method shows up than in the previous stock points. Obviously the mill operators believe that the ideal method is to stock them all with axis horizontal and one coil high. The one mill that stacks with axis vertical reports that if they had sufficient floor space, which they hope to obtain some day, they certainly would stock with axis horizontal and that they would much prefer to stock one high if possible. Obviously to stock with axis vertical at this point requires two upending operations, which are expensive and no doubt to some extent damage the material.

The questionnaire also contained questions regarding method of handling material to and from stock. It was once thought that these charts would be made up not only to show the method of stocking for each plant, but the method of getting the coil to and from stock. The complication of correlating all the information has prevented this being shown for each and every mill. But obviously most of the producers use cranes to stock ahead of the pickle line, as no other means would be practcial to pile coils to the height used by most mills. Tractors or cranes can be used to stock one high ahead of the cold mill.

Figure 4 shows unanimous opinion in that all producers stock cold reduced coils ahead of the cleaning line one high with axis horizontal. In general only tin mill coils are cleaned and the only producers reporting were tin mill producers. It would probably be almost impossible to use any other method of stocking at this particular point due to the slippery nature of the coils with the mill coolant adhering to them, and the great tendency of the inside diameters to collapse if handled roughly. At this point tractors are almost the universal method of handling to and from stock.

Figure 5 shows how coils are stocked ahead of annealing. By far the greatest number of producers stock with axis vertical, as might be expected, since the universal practice is to box anneal with the axis vertical, and continuous annealing is not practiced to any great extent as yet. Since the axis was horizontal on all coils coming from the cold mills and all coils coming from the cleaning lines, an upending operation must have been inserted at this point. This particular operation will be discussed later.

Figure 6 shows the method of stocking coils after annealing ahead of the temper mill. Obviously at some point between the annealing and the temper pass mill the coils must be laid down with their axis horizontal, as all temper mills take the coils in this manner and most annealing is done with axis vertical. This chart illustrates that the actual stock of the material is usually done before this downending operation.

Figure 7 shows the stocking of the coils between

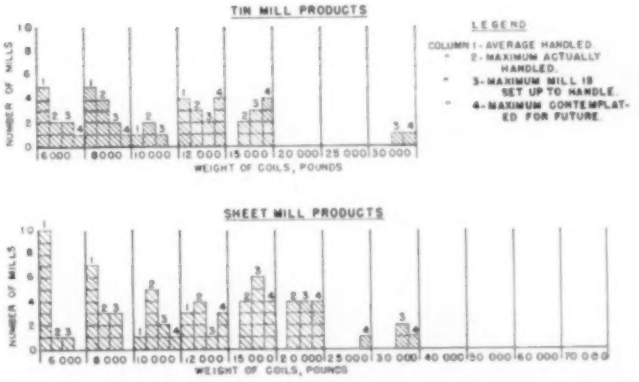
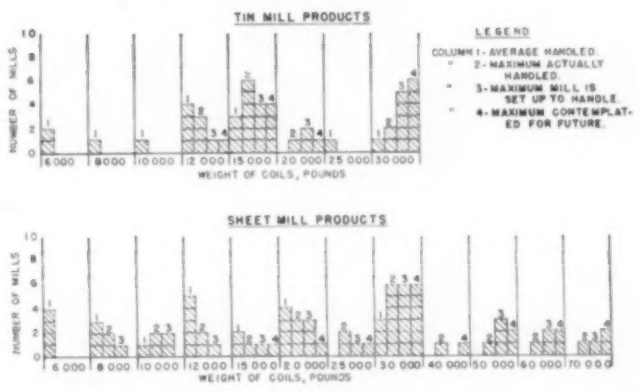

TIN MILL PRODUCTS
LEGEND
COLUMN 1 - AVERAGE HANDLED.
" 2 - MAXIMUM ACTUALLY HANDLED.
" 3 - MAXIMUM MILL IS SET UP TO HANDLE.
" 4 - MAXIMUM CONTEMPLATED FOR FUTURE.
NUMBER OF MILLS
6 000 8 000 10 000 12 000 15 000 20 000 25 000 30 000
WEIGHT OF COILS, POUNDS
SHEET MILL PRODUCTS
NUMBER OF MILLS
6 000 8 000 10 000 12 000 15 000 20 000 25 000 30 000 40 000 50 000 60 000 70 000
WEIGHT OF COILS, POUNDS

Figure 8 — Present weights of coils being delivered from hot mill is shown in this chart.

Figure 9 — The weight of coils delivered from the pickle line is greater than those delivered from the hot mill as can be seen by a comparison of this figure with Figure 8.


TIN MILL PRODUCTS
LEGEND
COLUMN 1 - AVERAGE HANDLED.
" 2 - MAXIMUM ACTUALLY HANDLED.
" 3 - MAXIMUM MILL IS SET UP TO HANDLE.
" 4 - MAXIMUM CONTEMPLATED FOR FUTURE.
NUMBER OF MILLS
6 000 8 000 10 000 12 000 15 000 20 000 25 000 30 000
WEIGHT OF COILS, POUNDS
SHEET MILL PRODUCTS
NUMBER OF MILLS
6 000 8 000 10 000 12 000 15 000 20 000 25 000 30 000 40 000 50 000 60 000 70 000
WEIGHT OF COILS, POUNDS

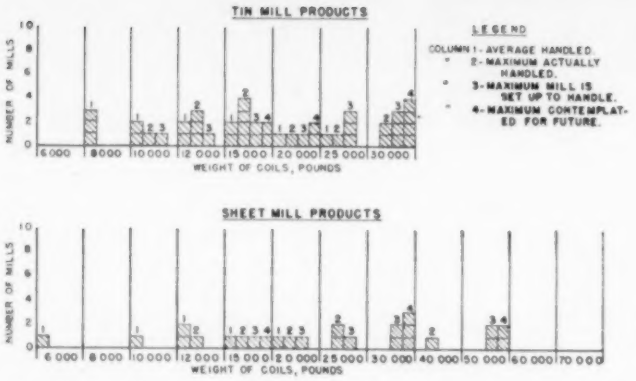

TIN MILL PRODUCTS
NUMBER OF MILLS
WEIGHT OF COILS, POUNDS
LEGEND
COLUMN 1 - AVERAGE HANDLED.
" 2 - MAXIMUM ACTUALLY HANDLED.
" 3 - MAXIMUM MILL IS SET UP TO HANDLE.
" 4 - MAXIMUM CONTEMPLATED FOR FUTURE.
SHEET MILL PRODUCTS
NUMBER OF MILLS
WEIGHT OF COILS, POUNDS

Figure 10 — Chart gives data on weight of coils at entry to coating line.

the temper mill and the shear lines. Since the coils are delivered from the temper mill with axis horizontal and fed into the shear line in the same manner, it is, of course, quite logical that all coils are stocked with axis horizontal. It is interesting that few mills believe it practical to stock more than one high at this point. In general this is the last point in most of the mills where any coils are stocked. Of course not all stocked coils after temper rolling are sheared —some of them are shipped in coil form. But the same method of stocking would apply as shown on this Figure 7.

In asking the questions regarding the method of handling to-and-from stock and method of stocking, each mill was also questioned as to the amount of damage they believed resulted to the coils from their particular methods. It was hoped that some conclusions could be drawn from these answers, as one would naturally suspect that the higher the coils were piled the greater the damage, and that methods of moving the coils from place to place might result in greater or less damage. Naturally, answers to such a question about damaging coils are greatly a matter of personal opinion, and possibly somewhat for this reason—or possibly because of different conditions in different mills—there seems to be little or no correspondence between the method of handling and the amount of damage reported. The mills were asked to indicate the condition of damage they encountered as either slight, moderate, or almost prohibitive. Those which checked neither condition were assumed to be reporting no damage, and consequently the four conditions of damage are:

1. No damage.
2. Slight damage.
3. Moderate damage.
4. Almost prohibitive damage.

Answers were almost evenly divided among the first three, with only one or two reporting that almost prohibitive damage was encountered at any point in their operation. It was also odd to note that the mills stacking coils the highest tended to report slight damage rather than even moderate damage.

Perhaps even of more importance than the method of stocking is the weight of coil which must be handled in the various mills. The questionnaire asked many questions regarding weight of coils at different points in the process.

Figure 8 shows weight of coils delivered from the hot strip mill. Here again the data has been divided into tin mill and sheet mill products and four answers from each mill are reported.

1. Average weight handled at present.
2. Maximum weight actually handled.
3. Maximum weight set up to handle.
4. Maximum weight contemplated for the future.

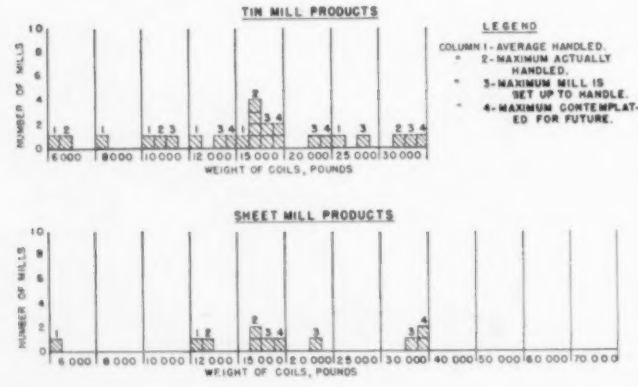
As might be expected, most mills are looking forward to handling heavier coils in the future than at present. For tin mill products it can be seen that 12,000 to 15,000 lb is the maximum that can be expected in any foreseeable future. The one mill mentioning 30,000 lb coils for the future does not as yet have a hot strip mill of its own and this report can be classified as wishful thinking. For sheet mill coils the future weights will be from 15,000 to 20,000 lb. It can be easily seen that few plants have reached this as yet—at least not as an average. This chart can be taken as a very striking example of the large amount of coil handling equipment that will need to be built in the next few years if the changes indicated are actually carried out.

Figure 9 shows the weight of coils reported to be delivered from the pickle line. It can easily be seen that a large amount of welding is contemplated as the coils delivered *from* the pickle line average very much heavier than the coils being delivered *to* the pickle line. Especially for tin mill products, the mills reporting light coils at present delivered to the pickle line are the ones reporting the heaviest coils delivered from the pickle line—both present and future. Mills that can deliver 12,000 and 15,000 lb to the pickle line—either now or in the future—appear to be fairly well satisfied with this and do not contemplate as much welding as do the mills that cannot foresee heavy coils from their hot strip mill.

The reports on sheet mill products show that practically all of these coils will be welded, either now or in the future, and some plants are being set up to handle extremely heavy coils. One producer has actually handled before this time coils of 70,000-lb weight and is gradually pushing his average weight of coil up to 1,000 lb per in. of width at the exit end of the pickle line and through subsequent processes.

It was assumed in the questionnaire that all coils would be carried at the same weight as they were

Figure 11 — Chart gives weight of coils delivered from coating line.


TIN MILL PRODUCTS
NUMBER OF MILLS
WEIGHT OF COILS, POUNDS
LEGEND
COLUMN 1 - AVERAGE HANDLED.
" 2 - MAXIMUM ACTUALLY HANDLED.
" 3 - MAXIMUM MILL IS SET UP TO HANDLE.
" 4 - MAXIMUM CONTEMPLATED FOR FUTURE.
SHEET MILL PRODUCTS
NUMBER OF MILLS
WEIGHT OF COILS, POUNDS

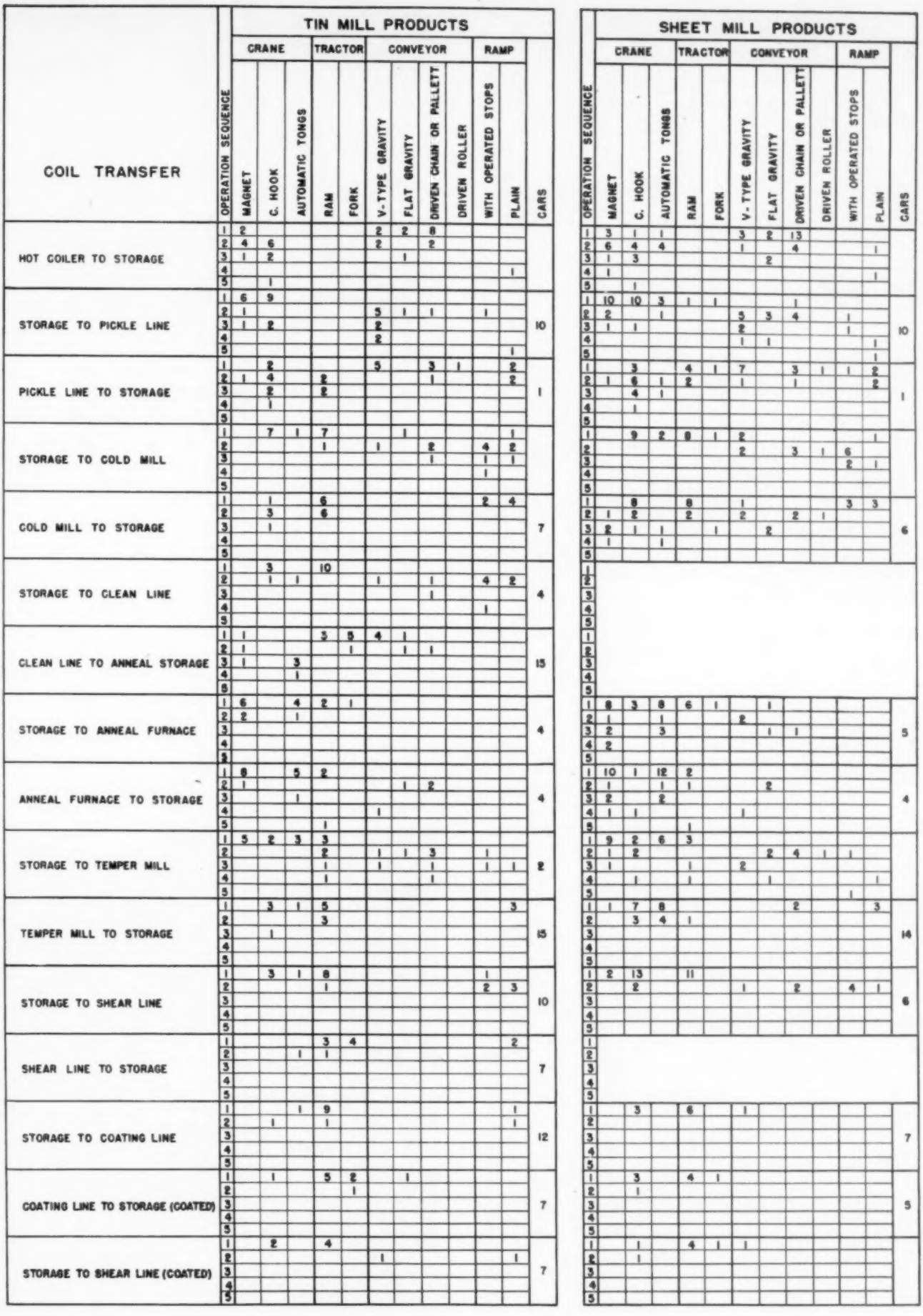


Figure 12 — Practice of various mills in handling coils is given by this chart.

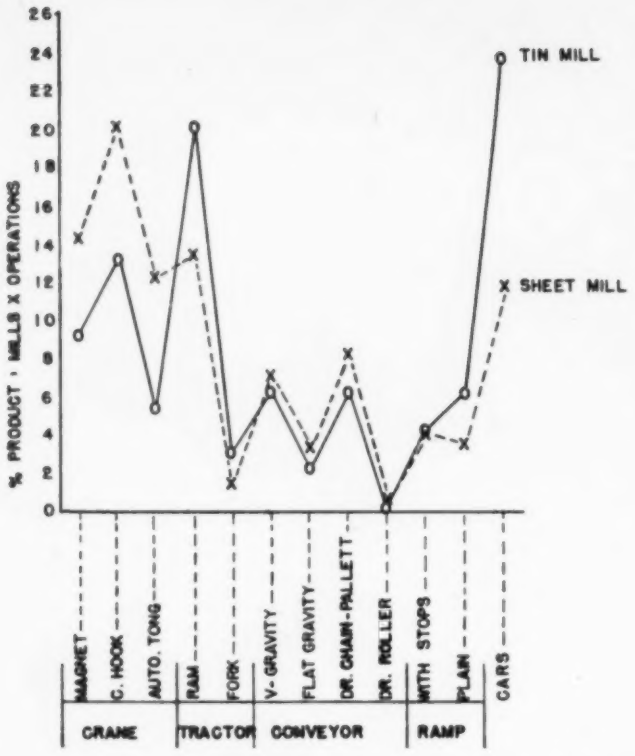


Figure 13 — This chart gives the percentage of total mills x operations for various types of materials handling equipment.

Figure 14 — Chart gives the maximum coil weights with the axis vertical recommended on ramps and flat gravity conveyors.

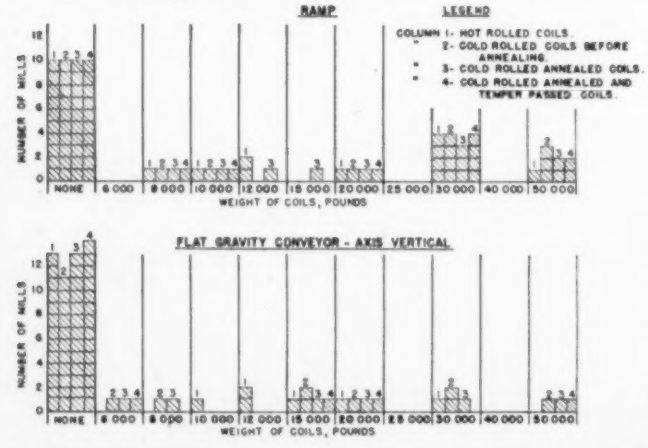


Figure 15 — Chart gives the maximum coil weights recommended for V-type gravity conveyors with the axis horizontal and for electric tractors.

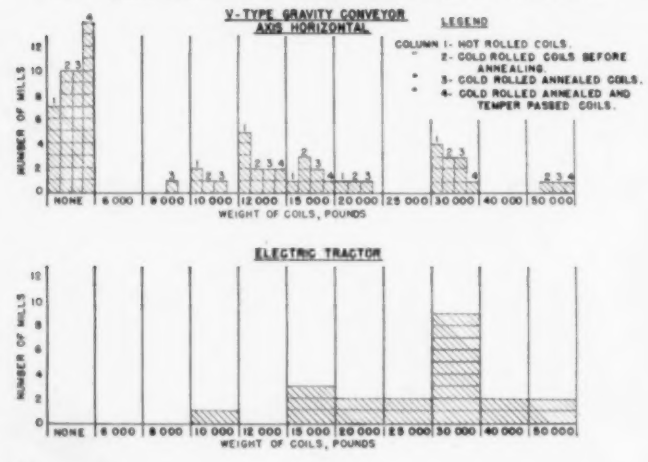
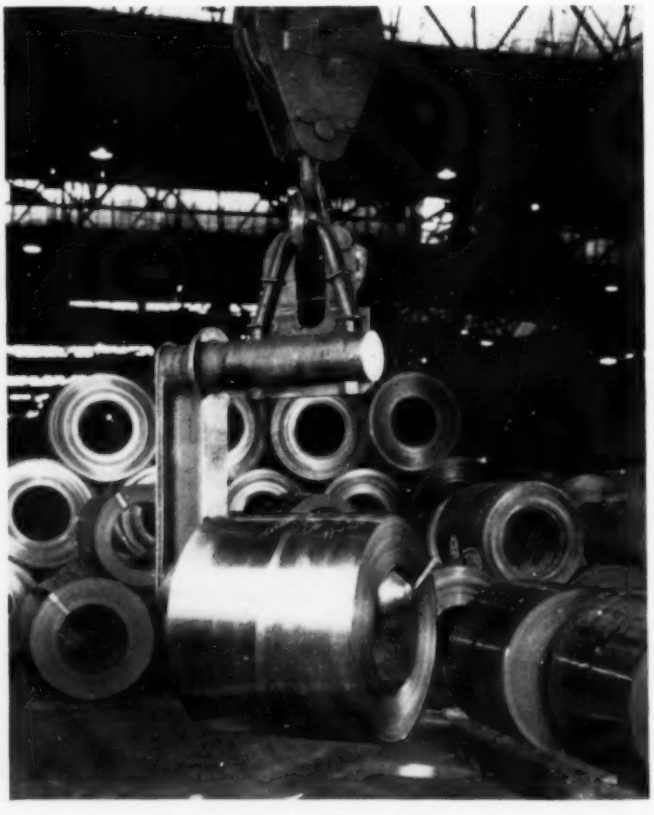


Figure 16 — One of the most common methods of stocking coils is with a ram tractor.

delivered from the pickle line through the cold reduction mill, cleaning line and up to the shear line, unless of course breakage occurred. Some answers to the questionnaire pointed out that this was not the case, as in some instances coils were actually cut to smaller size before annealing due to limitations in the size of annealing furnace, or were built up on the cleaning line to larger size than at the cold mill before annealing. Due to the fact that detailed answers to this question are not available, and such practices are not so very common, no charts are presented showing these intermediate steps.

Figure 10 shows the weight of coils delivered to the coating line, either tin coating or other coating for sheet mill products—and the results do not vary greatly from the weight of coils delivered from the

Figure 17 — C-hooks are commonly used to transfer coils with their axis horizontal.



pickle line. The maximum weight of coil contemplated at any coating line is 50,000 lb, which is probably due mostly to the fact that the maximum width of coil which can be coated on any existing lines is around 50 in.

Figure 11 shows the coils delivered from coating lines. Many coating lines, of course, deliver no coils, as the material is cut directly on the line and in general the coils delivered from the coating lines are smaller than the coils delivered to them, due to the fact that some of them are to be shipped directly to customers, and customers can not handle the large coils.

Having laid the ground work for the size of coil to be handled and where it must be handled, to and from, the question arises as to how it should be handled. There are many ways in which coils are handled, but these methods can be fairly easily broken down to a few general classifications:

1. By cranes.
2. By tractors.
3. By conveyors.
4. By ramps.
5. By cars.

Each of these subdivisions can be further broken down. Coils handled by cranes are usually lifted by magnets, C-hooks or automatic tongs.

Coils handled by tractors are usually held by a ram for coils with axis horizontal or fork for coils with axis vertical.

Types of conveyor consist of V-type gravity roller conveyor, flat gravity roller conveyor, driven roller conveyor, driven chain or pallet conveyor, and some variations of these.

Ramps can be divided into two classes—plain ramps or ramps with operated stops.

Various types of cars form in many ways the most commonly used method of coil handling. There are two general types of cars. One is a railroad type of car, which may or may not run on tracks, that moves coils from building to building, or down the length of the building. These are quite common in annealing departments, and are sometimes used in place of conveyors to handle coils from building to building. However, this is the less usual use of a car.

Most coil cars are used to deliver to or from a machine in a processing line. The processing uncoilers, which are almost universally used at the entry end of pickle lines and hot strip shearing lines, employ a coil car with driven cradle rolls to move the coil into receiving position in the machine. All mandrel or overhung type coil holders and reels employ coil cars, either to place the coil over the collapsed mandrel, or to remove it from the collapsed mandrel.

The movement of this type of car is usually rather short—say from 6 to 10 ft, although cars with travel of as much as 30 ft have been built and used with entire satisfaction. There is almost always incorporated a lift, which on modern designs is almost universally by hydraulic cylinder. The traverse movement is also usually by hydraulic cylinder, although many other methods have been used in the past.

Not because it can be understood in this meeting or by a quick study, but because it illustrates the great variety of ways in which coils are actually handled, Figure 12 is presented. This tabulates the answers of the mills for the way coils are actually handled at various points at the present time. Due to the fact that many operations, such as from hot

Figure 18 — Vertical coils are commonly handled with an electro-magnet.

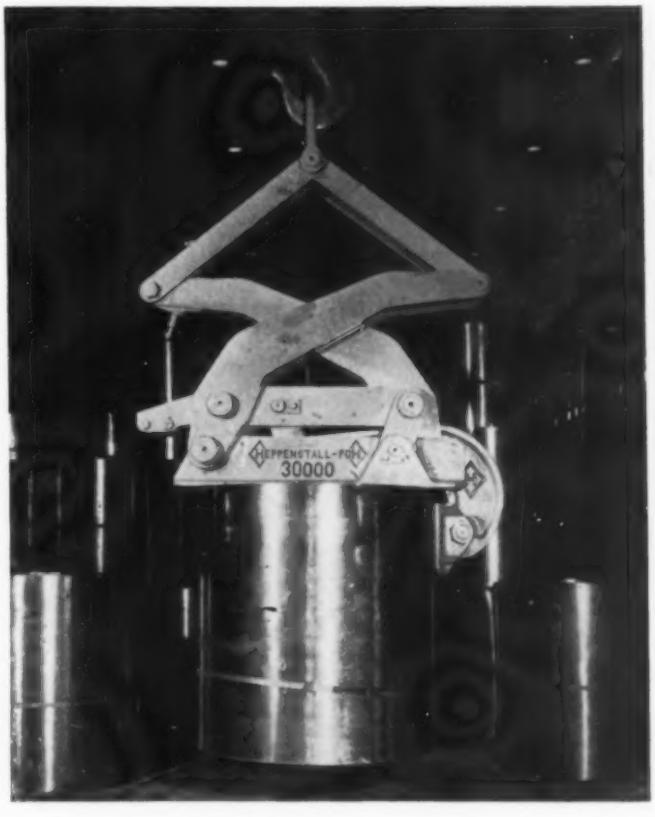


Figure 19 — Automatic tongs are also used for handling large coils.

coiler to storage, employ two, three or four methods of handling, there is a great complexity of answers. A careful study of this chart may possibly be of interest, but about all that can simply be said is that it shows many, many types of handling are employed —fairly well distributed among all of the different methods.

Figure 13 is an attempt to get a bird's eye view of how material is actually handled. The dotted line shows sheet mill products—the solid line tin mill products. The vertical coordinate shows percentage of mill operations in which the particular handling method is used. The horizontal coordinate is the different method of handling. Tin mill and sheet mill follow each other rather closely, except that more sheet mill coils are handled by crane and more tin mill coils by tractor. This is obviously due to the fact that sheet mill coils average heavier, which makes it more difficult to successfully employ a tractor. The same is true in connection with ramps where more tin mill coils are handled on ramps—this again being due to their lesser weight.

It can be seen that except for special cars used immediately adjacent to processing lines, cranes and tractors are the two most used methods of handling coils. Some of the answers to the questionnaire indicate that when proper designs are available, conveyors will find more and more applications, but for handling to and from stock, nothing is now in sight that can supplant the crane-tractor combination.

A rather interesting portion of the replies received from the mills were the answers to the question: "What is the maximum weight of coil that should be handled by the various means?" The question was broken down for various types of coils, that is:

1. Hot rolled coils.
2. Cold rolled coils before annealing.
3. Cold rolled coils after annealing.
4. Temper passed coils.

The first method of handling considered was the ramp. This method received an extremely poor vote from the mills questioned. Approximately one-half of them answering indicated that no coil should be handled on a ramp. On the other hand, two or three mills believe that it will be feasible to handle 50,000-lb coils on a ramp, and several recommend the handling of 30,000-lb coils by this means. See Figure 14. As more and more thought is given to the matter, it seems probable that the ten people who believe that no coil should be handled on a ramp will be able to convince the others that they are probably right. The great virtue of a ramp, of course, is its simplicity, resulting in low installation costs and low maintenance costs.

On Figure 14 are shown the answers to the question regarding the handling of material on a flat gravity conveyor. Obviously this must be done when coils are handled with axis vertical, as it is hardly practical to handle coils with the axis horizontal on

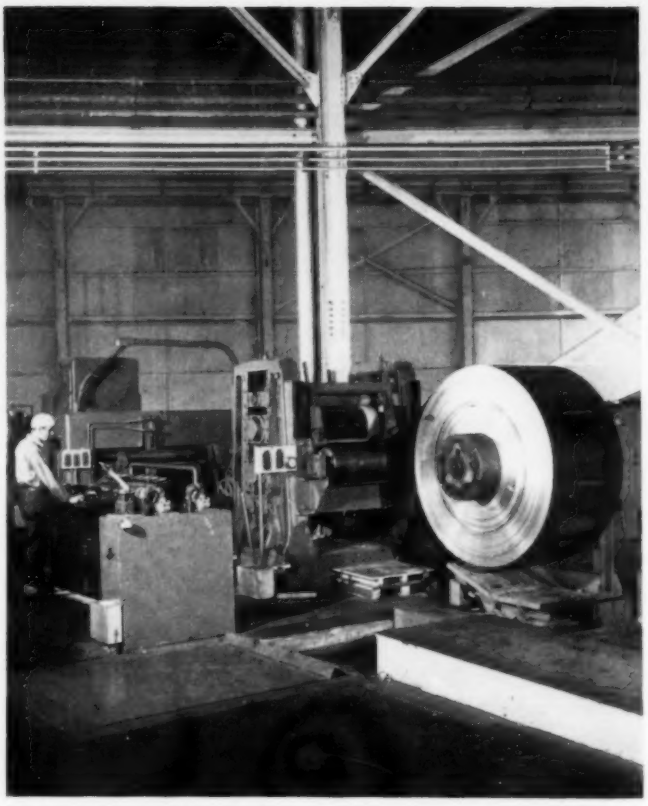


Figure 21 — The coil car will raise to support the coil while the reel head is collapsed and will then move laterally to remove the coil.

Figure 20 — The entry end of this processing line includes a ramp with an air-operated stop.

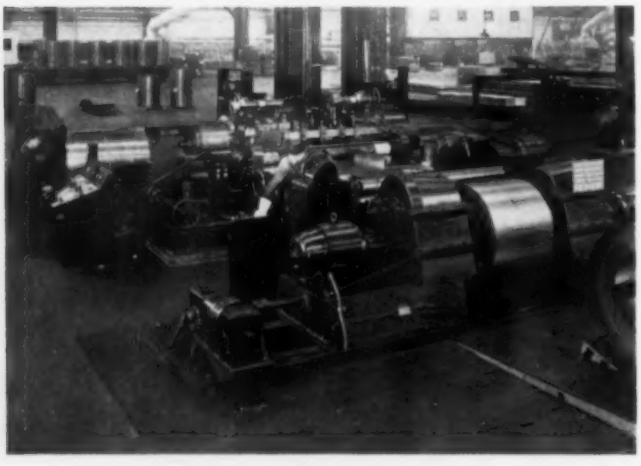
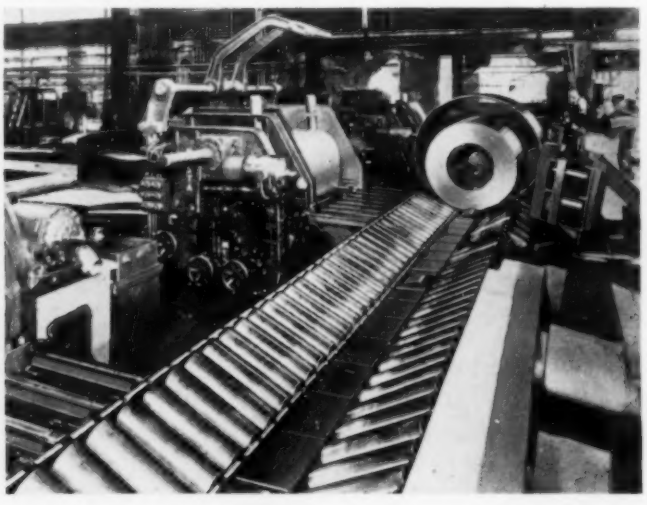


Figure 22 — This V-type roller conveyor utilizes a driven chain with dogs.



such a conveyor. This gravity conveyor received an even poorer endorsement than did the ramp, no doubt due to the great tendency of such conveyors to damage the edges of the strip. Since so many of these conveyors are actually in service, there is a wide field for installation of something better.

Figure 15 carries on the same question and shows the answers regarding V-type conveyor, which handles coils with the axis horizontal. For hot rolled coils this type of conveyor receives a better vote than does the flat gravity conveyor, due to the fact that it has less tendency to damage the coil edges, but still the consensus is that it should not be used with any great frequency. Very few plants agree that it is satisfactory for any size of cold rolled coil.

It is possible to minimize coil damage when using either type of gravity roller conveyor by the use of a steel plate between the coil and the rollers. The disadvantage of this system is the labor required to return the plates from exit to entry end of conveyor.

Figure 15 also shows the answers regarding tractor. It is unanimously agreed that the tractor is a good method for handling coils, since no one suggested that no coils should be handled by tractor. The prime question here is the weight that should be handled and only a few believe that anything over 30,000 lb should be handled by tractor.

There is at present, operating in one steel mill, several tractors designed to handle coils up to 60,000 lb in weight, 90 in. wide, and there are on order two additional tractors for another plant to handle coils 60,000-lb maximum weight, 60-in. wide. It is understood that these last two tractors will be diesel-electric, rather than battery-operated tractors.

No doubt the reason that most mills do not believe that tractors are entirely practical for handling coils over 30,000 lb in weight stems from two main factors:

1. Difficulty in building floors strong enough to support very heavy tractors with heavy loads.
2. The very wide aisles required to give such large tractors necessary turning radius to deliver coils to and from stock and to and from processing lines.

It is figured that a tractor to handle 30,000-lb coils requires a floor of heavily reinforced concrete at least 8-in. thick, with a 4-in. wood block top. Heavier tractors will of course, require heavier floors, and since the weight of the tractor must go up in about the same proportion as the weight of the coil it handles, the floor load increases rapidly with coil weight.

Tractors in general require quite wide aisles to maneuver and the length of the tractor increases with both coil weight and coil length. The larger tractors, therefore, require aisle room that is impossible to obtain in some mills and which is a large item of cost in all mills.

Other reasons that have been given by some of the plants opposed to the very heavy tractors are the high original cost and the high maintenance cost of tractors as compared to cranes. The complete truth of this, of course, cannot be proven until more of the very heavy tractors are in actual use.

The other general methods of handling—that is by driven pallet conveyor, by crane and by car—in the opinion of the mills reporting is satisfactory for the handling of the heaviest coils that can be made or that are contemplated in the future.

The usual mill crane, and the building which supports it, is of such size that even the very heaviest coils can be handled with few or no alterations. Since the crane is an essential in the building in any case, this makes crane handling of heavy sheet mill coils an easy solution to many problems.

Some disadvantages to the use of cranes have been pointed out, viz:

1. The crane operator is usually far removed from the place where he is picking up or setting down a coil, and particularly when setting it down finds it very difficult to deposit it gently on the pile of coils, floor or coil car, or wherever he is placing it. This frequently results in damage to the coil and damage to the equipment on which it is being placed. Although a second man is not required for many coil handling operations with a crane, when automatic tongs or magnets are being used, he is often employed to assist the craneman in placing the

Figure 23 — The ram tractor is shown delivering coils to the coil cars of a pay-off reel.

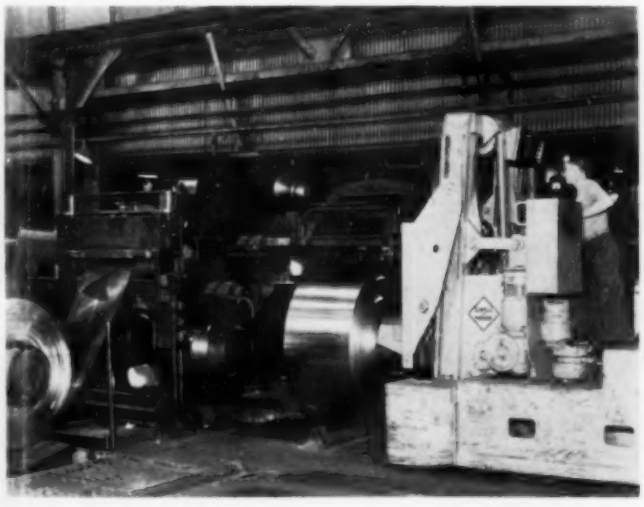


Figure 24 — This view of the entry end of a processing line shows a coil on the coil car of a pay-off reel.

Figure 25 — A pallet conveyor and short section of ramp are used to handle coils to the coil car of the pay-off reel of this processing line.

load accurately and carefully where it belongs. This extra man means more operating cost than is necessay with a tractor.

2. The cranes obviously cannot transfer coils from building to building, and when this is done without the use of a tractor, the crane must deposit the coil on a car or a conveyor which will move it to the next building and another crane must take it from there. This often means three handlings, two cranes and one car rather than one handling by a tractor. Even understanding this, certain mills maintain that the crane and car combination is cheaper than handling by tractor.
3. Where long transfers are to be made in a building, it is often practically impossible to run the crane from the location of the coil to the place where it is wanted, and about the same devices are resorted to as for transferring from building to building.

One place where a crane has a definite advantage over a tractor is in stocking coils when piled one on top of the other, especially if they are piled very high, the crane is the only practical method to use.

No arbitrary statement can be made as to exactly the proper time to use a crane and the proper time to use a tractor. The comments above are simply meant to point out some of the items that must be considered.

The fact that it is impossible to always have a crane or tractor available to charge a coil into a line or take it away from a line the instant that it is required makes some auxiliary handling between the crane or tractor and the line practically an essential. This is the point where the coil cars become most widely used, and if still more stocking is required, a combination of coil car and conveyor is valuable.

A coil car can normally stock one coil besides the one that is held in the machine. For relatively slow speed lines, using long coils, where it takes twenty minutes or longer to run a coil, this is often satisfactory. Many lines where continuous operation is important employ two coil holders and cars. On such lines a total of three coils can be stocked while one coil is running, and conveyors to stock more coils are usually omitted. A conveyor to stock several coils and deliver them one at a time to the coil car is used on lines where one or more of the following conditions may be present:

1. Short time to process one coil due to high speed of line or short coils.
2. Only one coil holder or reel used.
3. Crane or tractor has other duties besides stocking this line.
4. Coils are not damaged by transfer from conveyor to car.

To comply with the last item sometimes results in an elaborate scheme with high first cost.

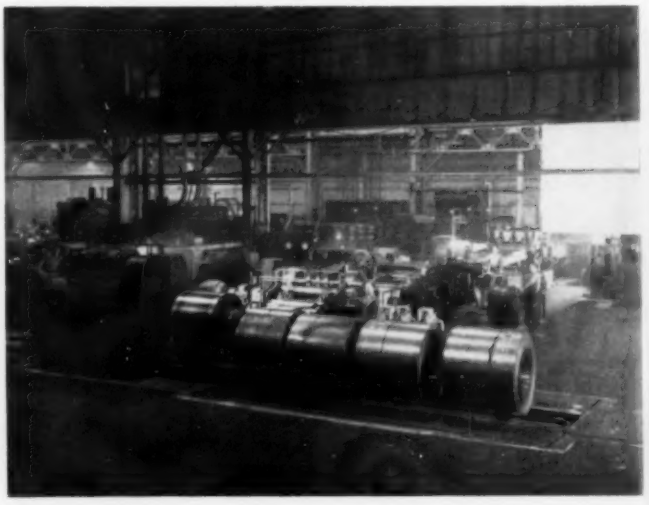
For any kind of stocking where coils may be removed from stock in a different order than they are placed in stock, a tractor or a crane is about the only practical means of operating. Coils can be stocked on conveyors or transfer cars, and, assuming that a rather long conveyor is used, a considerable number of coils can be stocked, but unless some handling means such as a crane or a tractor is used at some intermittent point, the coils must go to the next process in exactly the same order that they came from the preceding one, and this does not usually fit in with the mill schedules.

This short discussion simply indicates that no one means of handling coils will ever supplant all other means, and that an individual study of the problem is necessary for each and every coil handling situation.

Up to this point the paper has very generally presented the problem of coil handling in wide strip mills. We will now show some methods by which the problem has been solved in the past.

Figure 16 shows a method of stocking coils—prob-

Figure 26 — By utilizing a very long coil car traverse, several coils may be stored in position for the car at the entry end of the slide.



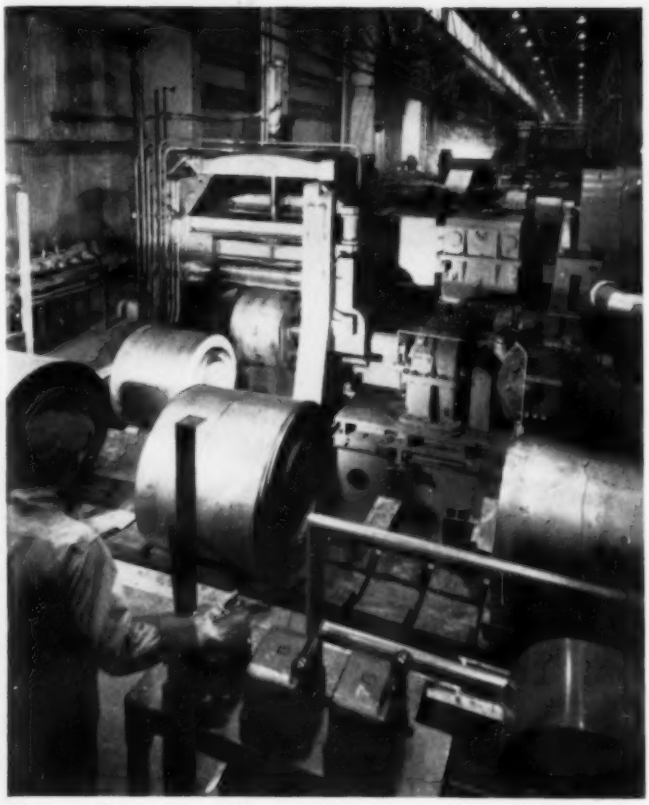


Figure 27 — A pallet conveyor, short ramp and coil car are used to feed coils into this processor.

ably pickled coils waiting cold reduction—by means of a ram tractor. Coils illustrated are sheet mill coils of a light weight and are being stocked in a manner probably satisfactory for their size. If the coils were larger and heavier, this tiering one on the other with axis horizontal would more than likely damage the coils by flattening. Any higher tiering of these light coils would also result in flattening. The method of handling by ram tractor is quite standard and probably entirely satisfactory.

Figure 17 shows coils stacked again with the axis horizontal, but by means of a C-hook from an overhead crane. The particular coils illustrated are cold reduced coils of somewhat greater weight per inch of width than the coils in the previous picture. The tightness of the wraps allows these coils to be stacked two or three high without excessive flattening, but not many mills actually follow this practice.

Figure 18 shows a standard way of stocking hot rolled coils ahead of a pickler and graphically illustrates the rather awe-inspiring height of coils piled six high with the axis vertical. The method of handling is again by overhead crane with a rather standard method of using an electro magnet.

Figure 19 shows coils stacked in the same manner, but this time being handled by a pair of automatic tongs rather than an electro magnet.

By "automatic" tongs, we refer to devices of the general type pictured, where the tongs grip and ungrip the material on alternate lifts. The tongs are now gripping the coil and the crane holds it clear of the floor. If the crane lowered the coil until the coil supported the weight of the tongs, the next time the tongs are lifted they would release the coil and come up empty. This type of automatic tong has been designed and built to handle coils up to a maximum weight of 80,000 lb.

Our data indicates that many more coils are now handled by magnet than by such automatic tongs, but there is some indication that the use of such tongs is on the increase.

These three pictures show the three principal methods of holding a coil from an overhead crane. Magnets and automatic tongs are used for both horizontal and vertical coils, while the C-hook can be used only for coils with axis horizontal.

Figure 20 illustrates the simplest means of moving the coil up to a processing line—that is by means of a ramp with an operated stop. Perhaps we should not say this is the simplest means, as a ramp without a stop is still simpler and is used at many points. When the operated stop is not used, coils are usually stopped by a workman throwing a piece of 2x4 or 4x4 wood in front of them on the ramp.

For light coils of heavy gage material and coils in the preliminary stages of manufacture, ramps can be used with little damage to the material. However,

Figure 28 — This retractable arm, turnstile and lift unit transfer coils from the coil car of the tension reel to a pallet conveyor with the result that the coils do not have to roll.

Figure 29 — Upenders are used here to change the coil axis.

as coil weight increases, as strip thickness decreases and as quality of the steel increases, more and more damage is done by rolling coils on ramps. Many materials such as wood, fibre, belting, bronze, etc. have been used to surface ramps in an endeavor to minimize such damage, none with any great amount of success. The low installation and maintenance cost of ramps will insure their use wherever possible for a long time to come.

The design of mechanically operated stops and ramps deserves careful consideration. The following points must be considered:

1. Simplicity.
2. Ruggedness.
3. Ease of movement while the weight of the coil is resting against it.
4. Width, to avoid turning the coil sideways if it does not hit the stop squarely.
5. Method of retracting to insure coil starting to move down the ramp, but not to propel it rapidly enough to cause damage to either the machinery or the strip material.
6. Accessibility of operating parts.
7. Many other usual considerations in the design of all strip mill machinery.

As mentioned previously, the simplest and least expensive type of stop is a piece of wood placed in front of the coil by the operator.

Figure 21 illustrates a standard reel coil car and a plain ramp frequently used for the discharge end of processing lines.

The coil car pictured is of a general type, rather universally used on reels. As the coil is completed, the platform is raised by hydraulic cylinder, or other means, into contact with the outside wraps of the coil. The head of the reel is collapsed, and the car is then, by power, moved outwards to remove the coil from the reel head. After it is clear of the head, the hydraulic lift is actuated to lower the coil, and the platform automatically tilts to roll the coil off of the car and onto the plain ramp shown in the right foreground.

There are many variations of this procedure, using approximately the same car. In some cases the platform on the car does not tilt and the coil is removed by crane or tractor; in other cases, it tilts when the car is raised rather than when it is lowered, and the coil is discharged at an elevated position onto an upender, a pallet conveyor, roller conveyor, or other handling means.

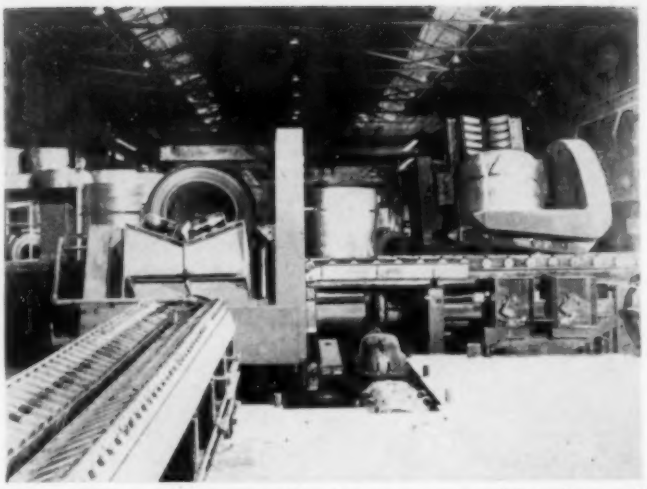


Figure 31 — Photograph shows a combination of upenders, gravity roller and pallet conveyor. The two side discharge down-tilters in this system discharge the hot strip coils at 90 degrees from a conveyor system to troughed gravity roll.

A simple V-type gravity conveyor may be used for transferring coils with their axis horizontal. For coils of small size, such conveyors are probably entirely satisfactory, although they are looked on with considerable disfavor for very heavy coils. For coils of relatively heavy gage and unfinished surface, damage from a roller conveyor is kept at a minimum.

Figure 22 shows a very similar operation employing V-type roller conveyor to which has been added a driven chain with dogs to move the coils rather than relying on gravity. This is definitely an improvement over the conveyor in the previous illustration. One advantage is that the conveyor can be horizontal at the point where the coil is discharged onto it. Gravity conveyors must be sloped which makes an additional problem in moving a coil from a machine which is set level to a conveyor on a slope.

Figure 30 — These upenders consist of sections of V-type and flat gravity roller conveyors.

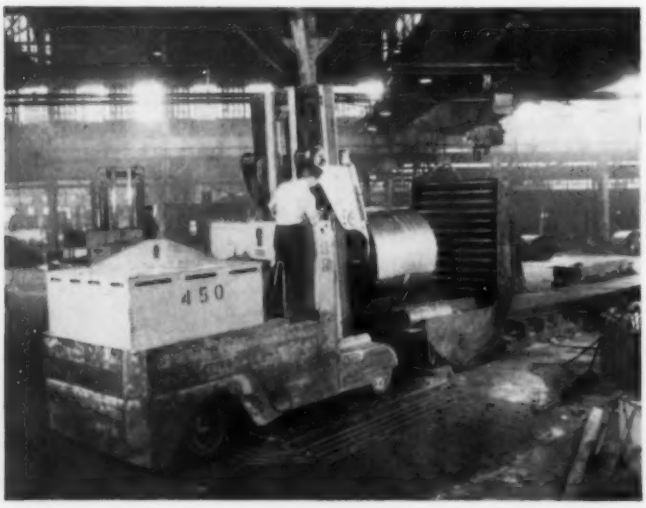


Figure 32 — The upender can be mounted on the tractor as is illustrated in this photograph.

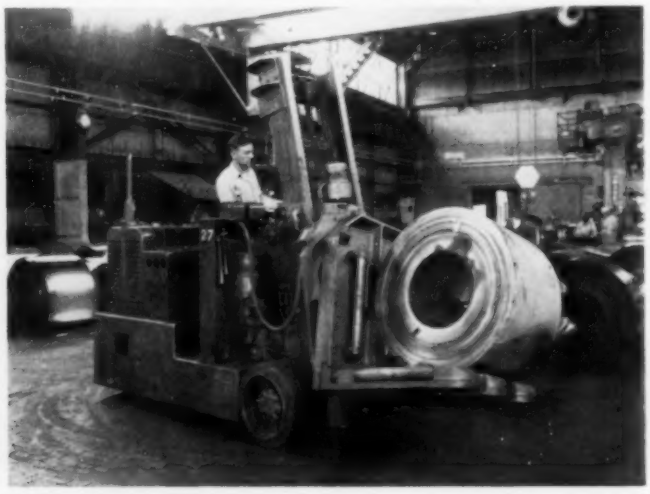


Figure 33 — The turntable at the exit of the processing line insures that the coil is wrapped in the right direction for the next process.

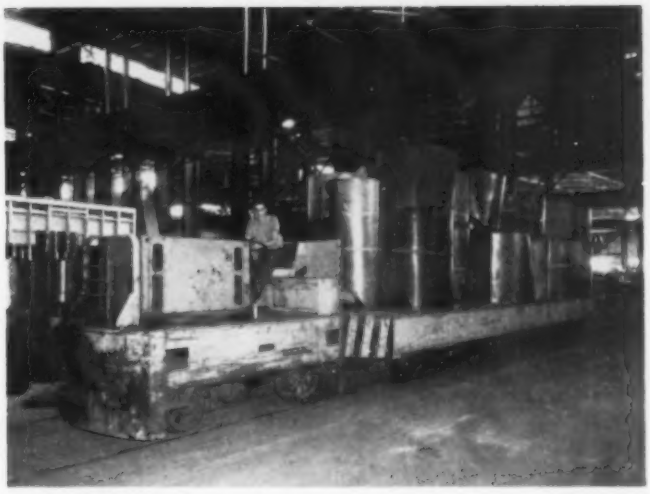


Figure 34 — A tractor drawn transfer car can be used when long runs or moves between buildings are required.

This fact was not always used to the best advantage as the picture very clearly illustrates a common difficulty in connection with such handling means. The coil has been discharged from the three-roll coiler shown in the middle of the picture and rolled down a short ramp dropping rather sharply into the V-type conveyor. As is quite usual, the outer wrap or wraps of what was probably a very excellent coil when resting in the coiler were loosened, and as the coil is pictured it will be very difficult to handle and stock satisfactorily. Great care in the design of relative positions of coil at the beginning and end of its travel, and length of ramps, etc., is essential to avoid conditions such as pictured.

Figure 23 shows a very standard, and very satisfactory, means of delivering finished coils to the entry end of a processing line. Such coils must be handled very carefully to avoid damage. The coil is lifted by a ram tractor and set by the tractor directly on the platform of a coil car, which in turn delivers it directly onto the overhung mandrel of the payoff reel. Various ramps and conveyors have been used between the payoff reel car and the tractor, but to avoid damage the tractor setting the coil directly on the coil car appears to be most desirable. The line pictured employs two coil holders which makes the use of a ramp or conveyor less necessary than where only one is used.

A similar condition is shown in Figure 24 where the tractor has deposited the coil on the car and left to pick up another coil. An extremely heavy floor plate must, of course, be provided as shown in the foreground to support the weight of the tractor and coil while it is in position to put the coil on the coil holder car. It should be stated that cranes can be used for the operation shown in the last two pictures. Probably the only disadvantage of using a crane instead of a tractor for this operation is the difficulty in setting the coil accurately and easily onto the car.

The coil cars used in connection with these overhung payoff reels are almost duplicates of the cars described in connection with the winding reel, and, indeed, the payoff reels are almost duplicates of the winding reels. The operation is the exact opposite of that described for winding reels, in that the car raises or lowers to a point where the eye of the coil is in line with the collapsed reel head, then moves to deposit the coil on the reel head, and after the head is expanded drops out of contact with the coil, and may be moved outward to receive another coil while the first one is being payed off of the coil holder head.

A satisfactory method of feeding a similar processing line where the coils can be rolled a short distance without damage is illustrated in Figure 25. Coils here are moved up to the line on a pallet conveyor which discharges them by rolling across a very short ramp onto the coil holder car. This particular line runs at 2000 fpm and has only one coil holder. These facts make the conveyor for stocking coils quite valuable.

It is possible to design a combination of pallet conveyor and coil car so that the coils are not rolled at all, and certainly this would result in less possibility of damaging the coil. Such a combination is expensive, and necessitates the exact indexing of the coils on the conveyor and the conveyor in relation to the coil car when the coil is being removed.

A rather different and unique method of delivering coils to an overhung coil holder is shown in Figure 26. Here it was considered inadvisable to roll the coils even the slightest amount, due to the fact that coils weighing up to 50,000 lb were to be handled. It was still desired to use only one payoff reel and to stock more than one coil while the line was running. Therefore, the coil holder car was given a very long travel from underneath the expanding mandrel clear to the right of the picture. A pair of rails was constructed to support four or five coils over the center line of the coil car travel, as shown. The car can come out and pick up each coil in turn, moving it either onto the expanding head or closer to it to provide more empty space on the rails at the far end. Coils are deposited on the rails by overhead cranes.

Tractors can be used to place coils on the rails at the extreme end, and then the coils can be moved inward by operating the coil car. Due to the fact that the particular line pictured is set up for handling 50,-

Figure 35 — These automatic tongs lift two coils simultaneously.

000-lb coils and the particular mill in which it is installed does not believe in the use of tractors for these heavy coils, cranes are actually used.

Another coil charging arrangement employing a short ramp is pictured in Figure 27, which shows an excellent means of charging coils into a processing uncoiler at the entry end.

Figure 36 — For coils with their axes horizontal, this type of automatic tongs can be used.

This coil car is similar in operation to the others described, but moves on the center line of the processing line. The mandrel, on which the coil is held, is retracted to allow the coil to be moved into processing position, and then inserted into the eye of the coil while the coil is held still by the coil car.

In this particular design of car, driven cradle rolls are employed to rotate the coil and feed the end up into the pinch or levelling rolls of the machine.

In general, coil cars for cold reduced material do not have such driven rolls, as the expanding head can be used to feed the end of the strip forward to the next machine. These processing uncoilers are used universally on hot rolled material, which is thick and, therefore, rather difficult to handle, and are not usually provided with driven expanding mandrel. The driven cradle rolls on the coil car are, therefore, very helpful.

This combination of a driven pallet conveyor and processing uncoiler with coil car is the most modern way of feeding a continuous strip pickle line, especially when using heavy coils. The short ramp between the pallet conveyor and the coil car is not especially detrimental if the relative positions of the various parts are carefully designed, and if the method of discharging the coil from the conveyor does not result in a rapid or violent movement.

In this installation the coil is pushed from the pallet conveyor by a hydraulically operated ram, which moves rather slowly, and is a large factor in insuring that the coil is placed rather gently on the cradle rolls of the coil car. Several mills now employ this method of feeding continuous picklers, and it appears to be very satisfactory indeed.

An unusual means of handling coils at the exit end of a processing line where coils are not allowed to roll at all, is shown in Figure 28. Here a conventional coil car takes the coil from the overhung mandrel and deposits it on the mandrel shown at approximately 45 degrees in the picture. This mandrel has an up-and-down motion, an in-and-out motion and a swinging motion in the horizontal plane. It lifts the coil from the buggy, turns 90 degrees, lowers, deposits it on the pallet conveyor seen in the immediate foreground, and is withdrawn. The very minimum damage to a coil is accomplished by such an operation, and an overhead crane or tractor is not necessary. A similar method could be used for charging coils at the entry end of a line where a coil car is used.

A method to accomplish a similar purpose is shown in Figure 29. At the exit end of a similar line it is desired to have coils with an axis vertical for delivering to the annealing department by tractor or overhead crane. The coil is deposited by means of a conventional reel buggy onto the rollers which are shown vertical in this picture. If it is deposited at the proper point, little or no movement of the coils on the rollers is necessary. The upender then turns the coil into a position with its axis vertical for being picked up by tractor or overhead crane.

This operation is quite common at the exit end of cleaning lines in tin mills, where the coil is always wound with axis horizontal on a reel, and usually is required in the annealing department with axis vertical.

Downlayers or upenders represent a large portion of the handling equipment necessary for moving coils from point to point in a mill. It should be remembered that the chart showed that coils are changed from axis vertical to axis horizontal several times in their progress through the finishing department.

A simple, and previously frequently used, upender is shown in Figure 30. This is a gravity roll machine where the coil is handled on a V-gravity conveyor when the axis is horizontal and on flat gravity rollers when the axis is vertical. This is the type of equipment frowned upon rather severely by most plants in their answers to the questionnaire, but which is still quite satisfactory for relatively light weight heavy gage coils.

Figure 31 shows two upenders employing a combination of a gravity roll and pallet conveyor.

This design illustrates the fact that gravity roller conveyors can be employed more safely for handling

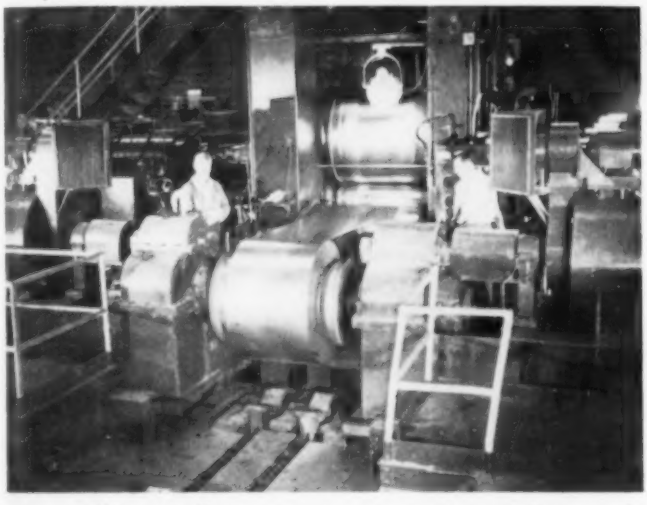


Figure 37 — Pallet conveyors sometime deliver coils directly to the center line of the uncoiler.

coils with the axis horizontal than for handling coils with axis vertical. The expensive pallet conveyors, and the special design downlayers, were installed in this case to assure the best handling with the least damage to the edge of the coils while the axis was vertical. It would have been possible to use pallet conveyors after the downlaying operation when the coils were moved with axis horizontal, but it was considered an unnecessary expense, and, therefore, the heavy duty V-type roller conveyors were installed.

Note that these are hot rolled coils, and for this application the V-type roller conveyor received a fairly good vote, as shown in Figure 15. For handling cold rolled coils in a similar operation, the V-type conveyor probably would not have been used.

Figure 32 is rather unique and has been used for only comparatively light coils. The upender is mounted directly on a tractor.

There has been some discussion of a design of an upending or turnover device for coils when they are

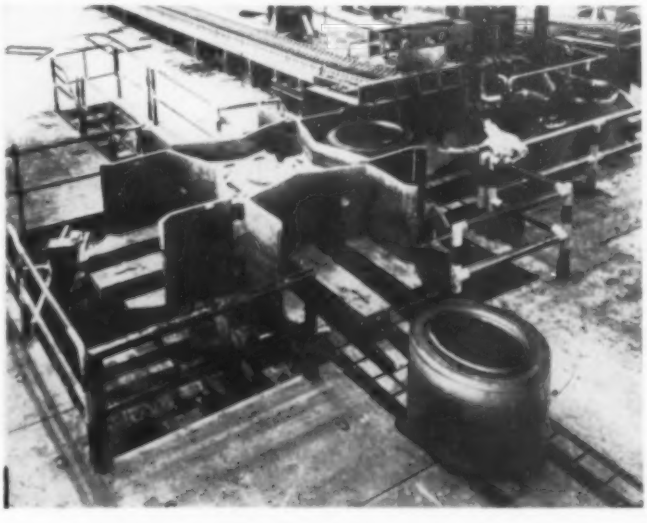
Figure 38 — Coils making a 90 degree change in direction, use a short section of gravity or driven rollers as a transition between two pallet conveyors.

held by an overhead crane. Some design work has been done on this, but the problem is quite complicated, considering the fact that the center of gravity of the coil is almost sure to change when it is turned 90 degrees. It seems rather unlikely at the present time that such a device will be developed for practical use, at least with heavy coils.

Another device sometimes used in connection with upenders is a turntable. Considerable trouble can develop in a strip mill if the coil is not wrapped in the right direction to deliver to the next process. Such a unit is illustrated in Figure 33 at the exit end of a pickle line where it is desired to turn the wraps in the opposite direction to deliver to the cold mill. A turntable is more frequently employed at the entry end of a pickle line when coils are stacked vertically ahead of it and delivered on a flat conveyor to the pickle line. Due to the mill layout, it is often impossible to have the wraps in the right direction without the use of a turntable.

The question of when a turntable is necessary can sometimes be quite complicated, especially if coils are

Figure 39 — This turntable can move the coils through a right angle from one pallet conveyor to another without rolling or sliding the coils.



to be received onto or taken from a conveyor system with axis vertical. Handling by crane with axis horizontal can always eliminate the necessity for a turntable by using the crane hook to turn the coil, but almost any other method of handling may make a turntable a valuable addition to a conveyor.

One miscellaneous type of coil transfer that has not been pictured, but was mentioned previously, is a transfer car, as illustrated in Figure 34. These are often used to run lengthwise of annealing departments, thus eliminating the necessity of long travel of overhead cranes.

This type of car is also very frequently used to move coils from building to building where overhead cranes rather than tractors are employed to handle the coils to and from stock. The car itself is a relatively inexpensive unit to install and gives a low maintenance cost. The only disadvantage of this transfer is that it is necessary to use a crane in one building, then the car (possibly pulled by a tractor), and a crane in the next building; whereas a ram tractor could handle the coil with one movement.

A type of automatic tong for use in connection with an overhead crane is illustrated in Figure 35. This particular one is designed for picking up two coils at a time. Although a hooker-up is illustrated in the picture, he is not necessary in many operations, as the tongs automatically clamp and unclamp at each successive time they are picked up by the crane.

Figure 36 illustrates a similar general type of tong, but arranged to handle coils with the axis horizontal.

One of the most advanced methods of delivering coils to a processing line at the entry end of a mill is illustrated in Figure 37. Here a driven chain type or pallet conveyor delivers the coil directly to the centerline of a cone type coil holder. A lift comes up between the pallets on the conveyor and lifts the coil into position for engagement by the cones. Such applications are somewhat expensive but result in minimum of damage to the coil.

The advantage of this system is that the coil never has to turn over at any time when resting on its outside periphery. This rolling, with the full weight of the coil supported on its outside wraps, is often quite detrimental to finished material, especially if the coil weight is rather large.

On this type of installation, it is necessary to have the coils deposited always in one place on the pallet conveyor, which explains the saddles shown in the picture. In addition, it is necessary to index these saddles accurately on the center line of the coil holder lift before the lift operates to pick the coils up from the pallet conveyor.

All of this adds to the complication and expense of the installation, however, a small percentage less damaged material easily justifies considerable extra cost of equipment.

In connection with conveyors in general, there seems to be a considerable feeling that the use of driven chain or pallet type conveyors will be greatly on the increase in future years. The most usually expressed concern in connection with such conveyors, in answers to the questionnaire, was how to obtain a good but reasonably priced pallet conveyor. Good ones (or at least pretty fair ones) are certainly on the market, whether or not they are reasonably priced will have to be decided by everyone to his own satisfaction. Certainly if anyone can come up with a design of pallet conveyor that is one-half as expensive as those now available and will stand the abuse inflicted upon it by handling of heavy coils in a steel mill, a ready market will be found.

Pallet conveyors are of several different types but most of the late ones possess the following features in common. Weight of coils is carried on anti-friction bearings to reduce friction and give less maintenance. Chains, rollers, saddles, and in fact almost all parts are constructed of steel to avoid breakage under repeated shock loads. Speed is kept at lowest practical figure to keep down maintenance and avoid excessive size of drive motors. When it is realized that some of these conveyors are hundreds of feet long and handle practically a solid load of heavy coils, it can be seen that at any high speed the driving power would be great and with such heavy loads, the maintenance especially on bearings would be very high.

No general figure can be given as to the speed of

Figure 40 — This automatic transfer arm receives coils from a car type conveyor and delivers them to a driven chain conveyor without damaging their edges.

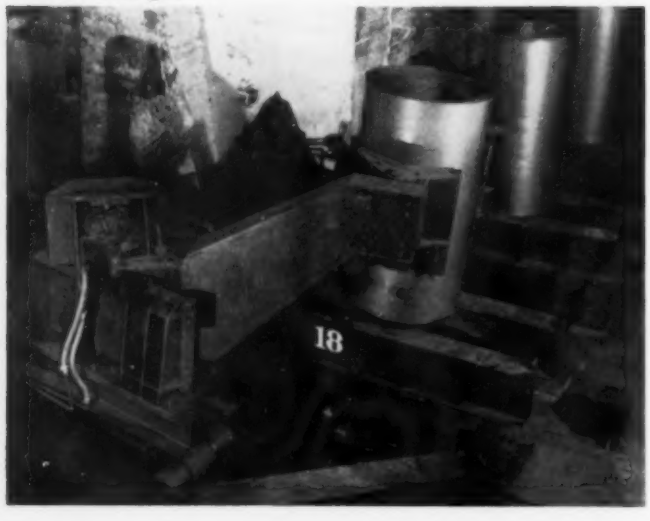


Figure 41 — The car type conveyor shown provides good circulation of air for cooling the hot coils.

a pallet conveyor, as each one must be figured for the particular job it is to do. The problem is set up by knowing the number of tons which a certain line or mill is to produce as a maximum and the weight and size of the coils to be handled. When these things are known, the theoretical speed can be figured to deliver a coil to the mill each time it is needed. On top of this, some allowance must be made for acceleration and deceleration of the conveyor, preparation of the end of the coil to be fed to the process, etc. Then allowing a certain factor of safety, the speed of the conveyor can be set.

Because of the very considerable interest in pallet conveyors in general, pictures showing some of the special problems involved in the use of pallet conveyors are of interest. Pallet conveyors are generally

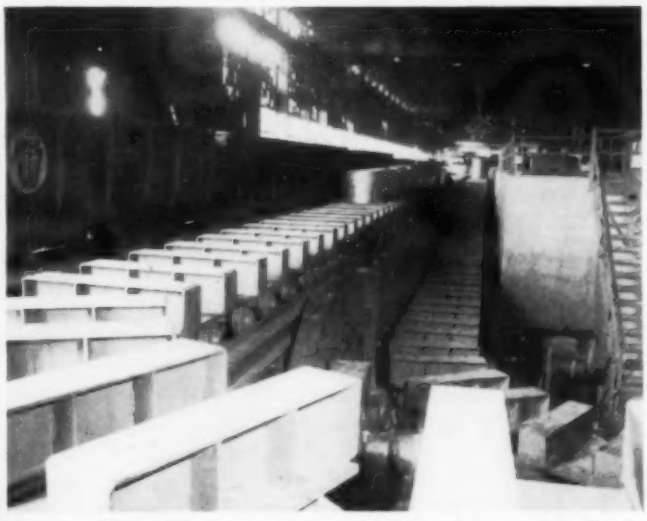


Figure 42 — The car type conveyor has great flexibility.

used to avoid rolling the coil or running it over rollers of any kind. To get away from this and still change direction of the coil movement, is a problem. Figure 38 shows a compromise in achieving this. The coils are turned at right angles from one pallet conveyor to another, but a few gravity or driven rollers are interposed to accomplish it.

Figure 39 shows a more advanced but certainly not a cheaper method of working to the same purpose. The large turntable in the center of the picture lifts the coil from one pallet conveyor, turns 90 degrees and deposits it on the other. This naturally will result in a minimum of coil damage and is probably the best device installed to date for accomplishing this job.

Figure 40 shows another way of picking the coil from a pallet conveyor. This might be described as a mechanical man. The danger with this type of equipment is that the coils may telescope as they are picked up.

Figure 41 shows a very elaborate system of pallet or car type conveyors, where the coils are placed on the pallets by means of heavy upenders or downlayers and taken off in the same manner. The conveyor, of course, must be perfectly indexed to allow them to operate. This conveyor travels a long distance underneath mill floor as shown in the picture,

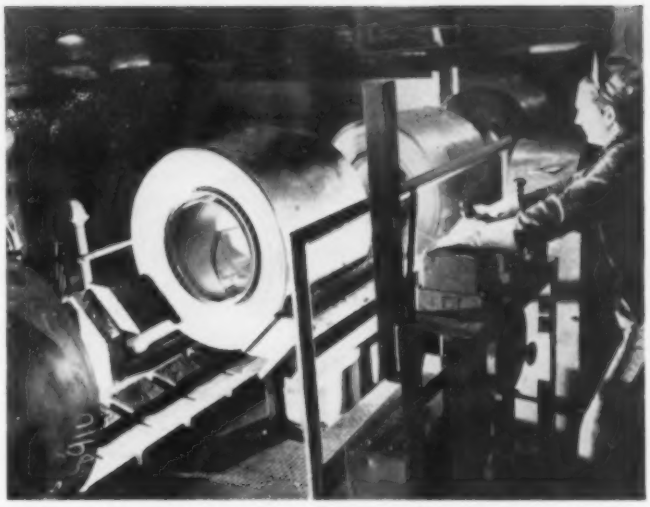


Figure 43 — At this weighing station, hydraulic fingers lift the coils from the pallet conveyor for weighing.

turns the corner at the end and returns, thus also giving considerable storage space.

The particular conveyor shown could perhaps be best called a series of coil cars in a continuous line, rather than a pallet or chain type conveyor. A single endless chain connects a large number of cars which run on rails. The chain, of course, is used for moving the cars, and the cars are arranged so they can go around curves—more or less the same as railroad cars.

A similar conveyor turning a corner is shown in Figure 42.

Weighing the coil being handled on the pallet conveyor is often desirable. It is hardly practical to simply support a portion of the conveyor on a scale platform as is often done with gravity roller conveyors. The physical connection of the parts not on the platform to the parts on it would result in a very inaccurate weight reading. In addition, the movement of the conveyor would be very damaging to the scale mechanism. One way of solving it, is shown in Figure 43, where hydraulically operated fingers come up each side of the pallet conveyor and lift the coil off for weighing.

It is hoped that by summarizing both the problem of coil handling in large strip mills, and illustrating sketchily what has been done in the past, engineers will be stimulated to develop more satisfactory methods in the future. To sum up again what appears to be necessary to improve coil handling:

1. Development of more, less expensive, more rugged power driven pallet or chain type conveyors.
2. Improved and less expensive upenders, downlayers and coil handlers to work in connection with pallet conveyors.
3. Improved means for handling coils by crane or tractor without damaging the edges. This probably applies principally to coils handled with the axis vertical.

No doubt with the cooperation of everyone these problems will come more nearly to being solved within the next few years.

Why Not Standardize Low Voltage A-C Starters?

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. . . . the practicability of developing an AISE standard for low voltage a-c starters is now being studied by a sub-committee of the AISE . . . .

▲ THE electrical and mechanical simplicity of the polyphase squirrel cage induction motor, and the reliability of performance associated therewith, is well known to all users of rotating electrical machines. In fact, few devices if any, excel it in simplicity for the conversion of electrical energy into mechanical power.

The principal objectives of this paper are, first; to establish the fact that the control of these machines is of paramount importance to the steelmaking industry, and second; to suggest that there is room for a co-operative venture on the part of users and makers of control for the establishment of a basic standard for low voltage a-c starters. In support of the first objective, let us cite a few figures as to why the a-c low voltage starter problem is important. This will refresh those who by years of habit have associated the steel industry principally with the d-c motor driven auxiliary and accessory machine. Here are some typical figures.

An installation of motors and control on a 36 in. continuous galvanizing line consisted of 21 d-c motors, totalling 223-hp. The same line had installed 39 a-c motors having a total of 783 hp or a-c horsepower equal to 3½ times the d-c horsepower. The a-c motors were 440-v, 3-phase, 60-cycle squirrel cage machines, ranging from ½ hp to 250 hp. Another widely different, typical installation such as 75 in., 4-stand, tandem cold mill had 22 a-c auxiliary motors associated with the mill for a total of 376 hp and ranging in size from 1 hp to 100 hp at 440 v, 3 phase, 60 cycles. These two installations, although widely different in their character, are felt to be quite typical in their utilization of low voltage a-c motors and control.

The second objective is really an appeal for serious consideration by the standards writing group of the AISE, of the problem of evolving a minimum basic standard for control equipment for the low voltage a-c squirrel cage motor. The eventual outcome can only mean control which is better suited to the steel industry's needs, with the obvious economic advantages associated with standardization. This suggestion is not without precedent. For example, the d-c mill motor standard (AISE Standard Number 1); the electric overhead traveling crane specifications (AISE Standard Number 6); the control standard for auxiliary and accessory machine controllers (NEMA IC13-10); and the pending standards of brake wheel sizes are all the result of tackling a problem which needed to be solved. It is true that individual practices or preferences may call for variations in any basic standard, but this does not mean that standards are impractical. On the contrary, if there is enough deviation of a related nature, from any basic standard, then the special of today becomes the standard of tomorrow.

But this second objective and appeal presupposes that there is a wide divergence of opinion and practice in the equipment used for starting low voltage a-c induction motors. It is the demonstration of this fact, together with some further conclusions and suggestions, that the remainder of this paper concerns itself.

SCOPE OF PROBLEM

It is well to establish some boundaries of the problem to be treated, for the electrical machine itself does not restrict the control problem sufficiently to resolve it to fundamental considerations. For example, the polyphase squirrel cage induction motor can be started, stopped, plugged, reversed, operated at reduced speed and torque, and even dynamically

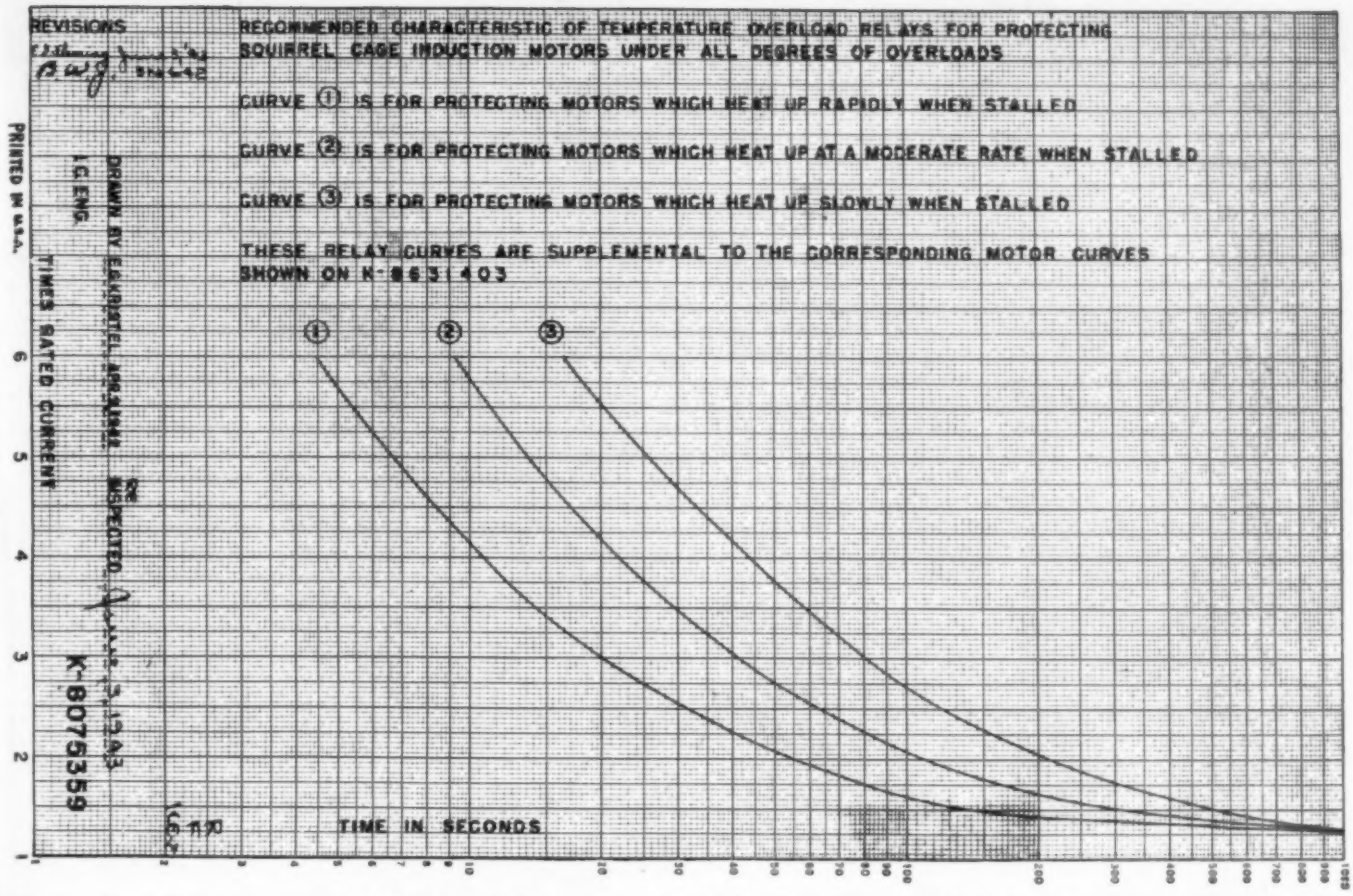

REVISIONS
RECOMMENDED CHARACTERISTIC OF TEMPERATURE OVERLOAD RELAYS FOR PROTECTING SQUIRREL CAGE INDUCTION MOTORS UNDER ALL DEGREES OF OVERLOADS
CURVE ① IS FOR PROTECTING MOTORS WHICH HEAT UP RAPIDLY WHEN STALLED
CURVE ② IS FOR PROTECTING MOTORS WHICH HEAT UP AT A MODERATE RATE WHEN STALLED
CURVE ③ IS FOR PROTECTING MOTORS WHICH HEAT UP SLOWLY WHEN STALLED
THESE RELAY CURVES ARE SUPPLEMENTAL TO THE CORRESPONDING MOTOR CURVES SHOWN ON K-863403
DRAWN BY
I.C.ENG.
TIMES RATED CURRENT
TIME IN SECONDS
K-8075359

Figure 1 — Time vs current characteristic curve of overload relays needed to protect modern motors.

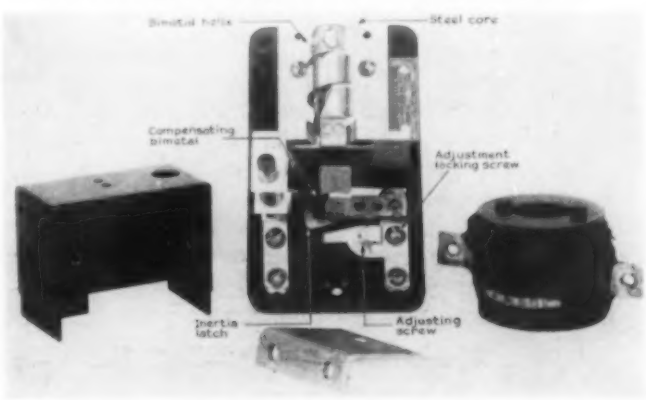
braked. Within these limits, then, the same motor is as versatile as the control connected to it. But, the same motor can be started and stopped with the simplest of control devices such as a manually operated three-pole knife switch. Therefore, the analysis of the problem will be confined to the magnetic, full-voltage starting, and complete protection of a-c constant speed squirrel cage induction motors, operating from power supplies of 600 v or below. This starter must connect and disconnect a motor from the line at the command of a pilot circuit device; must provide adequate motor-running-overcurrent protection under any condition of load, including a stalled condition; must provide unfailing motor-branch-circuit overcurrent-protection against short circuits and grounds; and must do all these things for many operations (several million) under the ambient conditions of dust, dirt, moderate vibration, wide variations in ambient temperature and whatever other local conditions are dictated in steel mill use.

The foregoing is merely a broad functional specification, far from complete, but it outlines the confines of this paper.

This paper will document with illustrations the fact that there has been a wide variety of starters built to meet the functional requirements just mentioned above. Admittedly there were some starters, which will be shown, which were designed to meet additional requirements, but for the most part they meet the use intended by our stated scope. Essentially, they are what is referred to as enclosed, a-c combination, magnetic starters and can be reduced, for analysis, to the following elemental devices:

1. An *a-c magnetic contactor* for switching the power circuit.
2. An *overload relay* to provide protection to the motor against injurious heating from running overload.
3. A *manually operated motor circuit switch*, usually capable of interrupting locked rotor values of current for disconnecting the starter.
4. A *motor-branch-circuit overcurrent device* to protect against short circuits and grounds. Such devices as NEC fuses or air circuit breakers are used for this device. In the case of air circuit

Figure 2 — An ambient compensated induction thermal overload relay is shown dissembled.



breakers, the functions of element number three and element number four can be combined in one device.

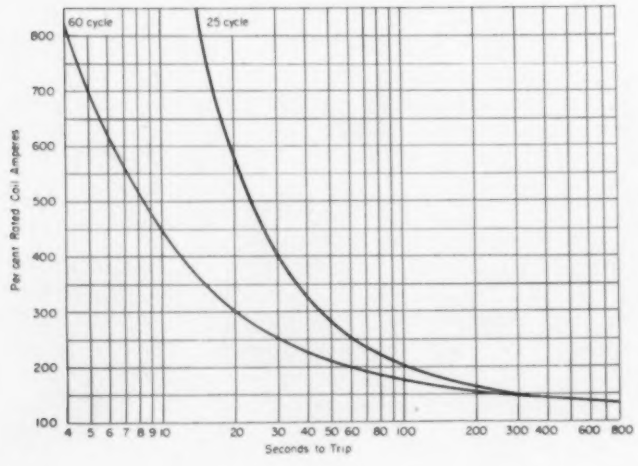
5. An *enclosure* to provide safety to personnel and also provide an adequate protection to the operating parts from whatever ambient conditions prevail at the point of installation.
6. *Individual variations.* These consist of such additional refinement as control circuit transformers, phase failure relays, extra relaying contactors and the like.

The ramification of the starters which have been built over the past years can be conveniently appraised on the basis of the variations in each of the foregoing elements. However, before doing that, existing standards should be examined (ASA C19; AIME 15; NEMA 45-97) pertaining to this equipment to find out what industry should expect of each element.

THE MAGNETIC CONTACTOR

The ampere ratings of low voltage a-c contactors for standard, enclosed, full-voltage magnetic starters should be 90 per cent of their standard 8-hour open rating. This means that the full load current of the induction motor, including any service factor, should not exceed this ampere rating. This defines simply the current carrying capacity of the contactor, but there are other limitations which are imposed on the magnetic contactor by virtue of its being rated in horsepower. All control designed to meet NEMA Class A conditions, must have an interrupting capacity to interrupt 10 times the normal motor current rating, and further have a 1-sec thermal capacity of 15 times the normal current rating. Thus, it is conceivable that the actual interrupting ability of a contactor may be the limiting factor of its rating, before the continuous ampere rating becomes the limit. This is especially true in the smaller sizes of contactors, but is seldom true in contactor ratings above NEMA size 3 (100-ampere, 8-hour open rating). By definition all standard control designed for special and heavy duty, such as steel mill auxiliaries, crane hoists and the like, are NEMA Class A controllers.

Figure 3 — Time vs current characteristics of an induction thermal overload relay.



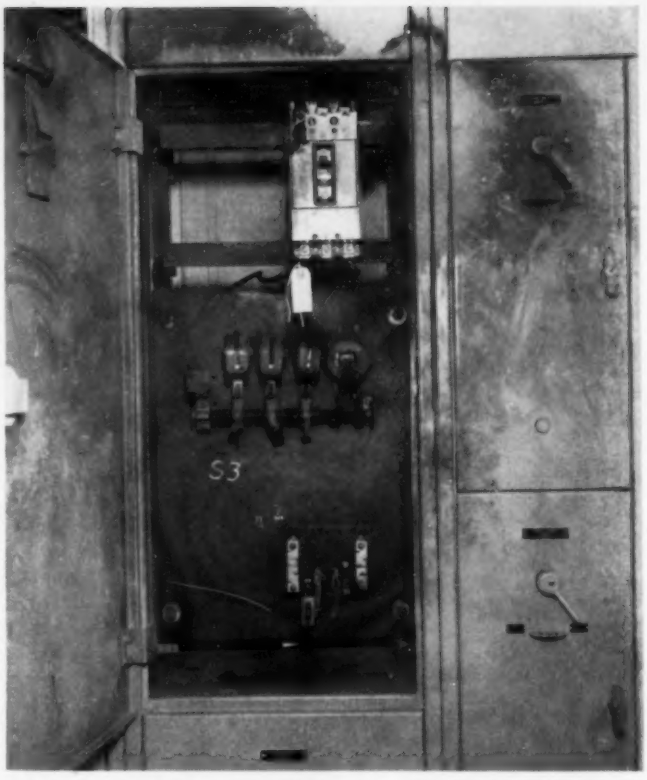


Figure 4 — A 30-hp, 440-v, air circuit breaker type of combination magnetic switch after short-circuit tests at 25,000 amp available shows marked effects from the short.

Durability and the yardstick for appraising the same are something for which no standards exist, although serious thought has been given to some universally acceptable means for appraising durability and sturdiness. Suffice it to say however, that long trouble-free operation with the minimum of maintenance is one of the requirements of a contactor for this service. The endurance tests of the Underwriters' Laboratories, Inc.'s standards for industrial control equipment could hardly be looked upon as a test for suitability for installation in the modern steel mill.

THE OVERLOAD RELAY

The obvious purpose of an overload relay is to cause and maintain the interruption of current flow to the device protected whenever an excessive current, but not necessarily a short-circuit current, occurs. In other words, the operating overloads which are encountered in practice, all the way from a normal to a locked rotor condition, are construed to be protected by overload relays. Although the standards place the maximum operating overload current at six times normal full load current for alternating current control apparatus, it is obvious that there are many designs of squirrel cage induction motors having locked rotor currents considerably in excess of this value, say, ten times normal. Since the controllers are rated in horsepower and voltage without reference to other motor characteristics (speed and torque), a well designed controller must be able to cope with these values of current and provide adequate motor over-

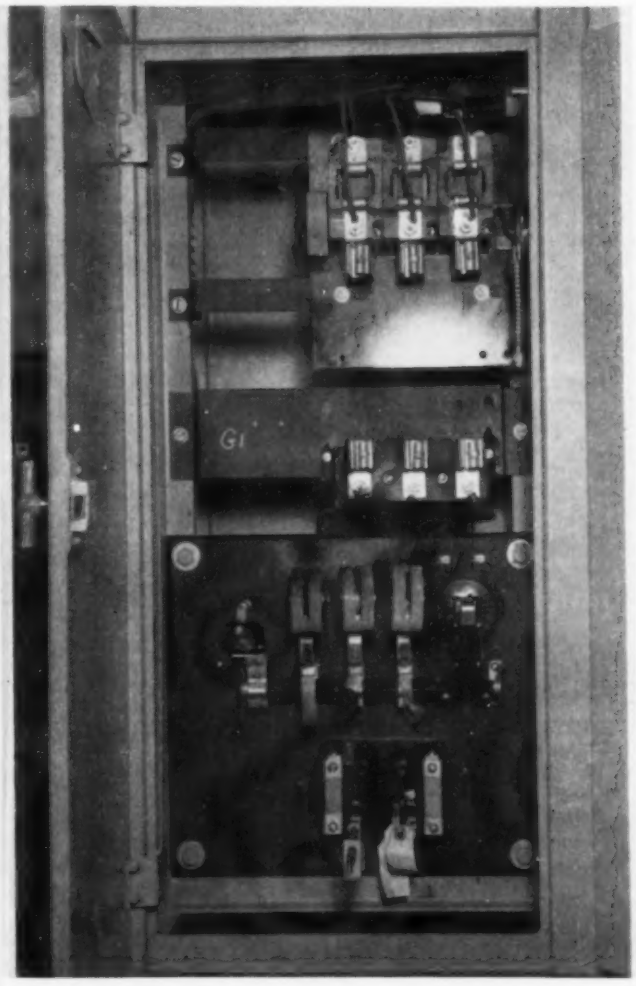
current protection. The National Electrical Code is quite explicit as to what is meant by motor overcurrent protection when it says "the following provisions specify overcurrent devices intended to protect the *motors*, the *motor control apparatus* and the branch circuit *conductors* against excessive heating due to motor overloads".

The control designers' problem today is to design relays which will adequately protect modern squirrel cage induction motors over the wide range of currents required of them. How can these requirements be generalized?

As an example of the great difference in motor characteristics and the consequent difference in overload relay characteristics to protect them, attention is called to Figure 1. On the one hand, Curve No. 1 is typical of a short-time constant motor such as one with a high resistance rotor, whereas Curve No. 3 is typical of a long-time constant motor typical of a totally enclosed fan cooled machine. Curve No. 2 is typical of the general purpose open type 40 C rise squirrel cage induction motor and this characteristic is recommended for consideration as the general characteristic for adequate motor protection.

An average polyphase squirrel cage induction motor having 600 per cent locked rotor current will have an allowable stalled time in the vicinity of 20 seconds.

Figure 5 — A 30-hp, 440-v fusible motor circuit switch type combination magnetic switch after short-circuit tests at 50,000 amp.



The trend in the motor design art is to have less and less allowable stalled time and the control industry is striving to keep pace with overload relays to meet these characteristics. The problem is made more stringent by the fact that this protection must be provided when the power supply has been single phased and only 86.6 per cent of the normal locked rotor current is flowing. Also coupled with this fact may be the service factor of an open type 40 C rise a-c machine, which has a 15 per cent service factor. When all of these factors are taken into consideration, it simply means that an overload relay must start from a cold condition and arrive at the trip point in 20 seconds with only 452 per cent of its normal rating flowing in the circuit. This requirement, in itself, would not be too difficult to meet on the basis of sheer operating speed, but there is usually a penalty to be paid for speeding up overload relays, especially those of the resistively heated type. In order to speed up the transfer of heat between the nichrome heat-producer and the bi-metallic heat absorber, a higher value of temperature of the heater is resorted to, even a bright red under stalled motor conditions. Such temperatures are not damaging to nichrome, but when a short circuit occurs the temperature reaches such a value that it becomes a problem to keep the heater from becoming a "fuse". Speed of operation of this type of relay and short circuit "withstand" ability are just opposite to the inherent characteristics of the device.

Induction thermal relays, which use a series coil to produce flux, and a thermal element directly or indirectly heated by transformer action between the coil and a short-circuited secondary, inherently have the high thermal and magnetic strength. Recently such relays have been introduced with speeds matching the fastest resistive type. The electrical and mechanical sturdiness of the induction thermal relay, together with inherent ambient compensation, has often warranted its use in steel mills at considerably more investment than for the heater type. Typical of the induction thermal overload relay with ambient compensated features is the one shown in Figure 2. Even its characteristic on 25 cycles can be made to closely approach the general purpose Curve No. 2 of Figure 1 as indicated in Figure 3.

The ambient compensation of thermal overload relays is a recurrent subject. More and more it seems to be indicated that in the steel industry and some other industries where wide swings of ambient temperature are encountered, the ambient compensated overload relay may be highly desirable. It must not be understood, however, as the "cure-all" for motor protection, for it is essentially a constant current relay. This characteristic does not allow a motor operating in a very cool ambient to carry more load, nor does it restrain a motor operating in an exceedingly high ambient from carrying more load than it should. The ambient compensated overload relay does have a value where exposure to the sun or other conditions creates cyclic or seasonal fluctuations of ambient temperature inside an enclosure, thus causing premature tripping or inadequate overload protection for the motor.

MOTOR-BRANCH-CIRCUIT OVERCURRENT-PROTECTION

The intention of motor-branch-circuit overcurrent-protection is to protect the motor-branch-circuit conductors, the motor control apparatus and the motors against overcurrents due to short circuits or grounds. Notice here that it has nothing to do with the load imposed on the output shaft of the motor or the size of the motor. Short-circuit duty is dependent upon the system available. The unfortunate part of the National Electrical Code definition for this type of protection is that it failed to put numbers on what constitutes a short circuit and therein lies the ground for a considerable discussion and difference of opinion as to what constitutes good practice and good equipment to accomplish this result. However, on 440-volt, 3-phase systems with only a moderately "stiff" primary feeder supplying the sub-station, short-circuit values of over 20,000 amp can be obtained from a 750-kva transformer bank and its motor load, and one has only to go to a 1500-kva bank and motor load when the short-circuit duty on the 440-v bus approaches 50,000 amp.

In the past, there have been two types of interrupters generally used to provide this protection to combination magnetic starters. The first one, the NEC fuse is the oldest type of short-circuit protection known to the electrical industry and within certain limitations provides today very high grade protection. The small air circuit breaker, sometimes referred to as the plastic case breaker, is the second popular form of interrupter used to give motor-branch-circuit protection. If we confine our appraisal of these two devices strictly to their current interrupting ability, we will find they are of different character in their operation.

The literature of the art is well documented[1] [2]* with the ability of the NEC fuse to provide excellent short-circuit protection to combination motor starters up to and including NEMA size 3 (50 hp at 440 v) when connected to power supplies capable of producing 50,000 rms amp short circuit. The current limiting ability of the fuse ratings associated with these starters, aided by the impedance of the starters themselves, represent a combination which has a low energy value of "let-through" current. Remember that it is not current alone that plays havoc with the small a-c motor starters, but the expenditure of energy, which is represented as the product of the current squared multiplied by *time*. This paper fully recognizes that the NEC fuse by itself does not yet have any recognized interrupting capacity over and above the 10,000 amp available value required by Underwriters' Laboratories, Inc.,[3] but those who have the facilities to do so have made adequate tests on alternating current and found them to be excellent protection within the range stated above. Now, with the advent of the new low voltage current-limiting power fuse, which will bear an interrupting rating of 100,000 amp available, there will be little need for explaining what the interrupting capacity of the fuse is or describing where the short circuit must occur.

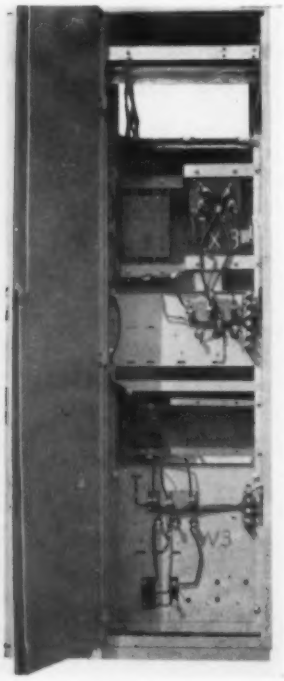


Figure 6 — Magnetic forces had an appreciable effect on back-of-panel wiring during short circuit tests.

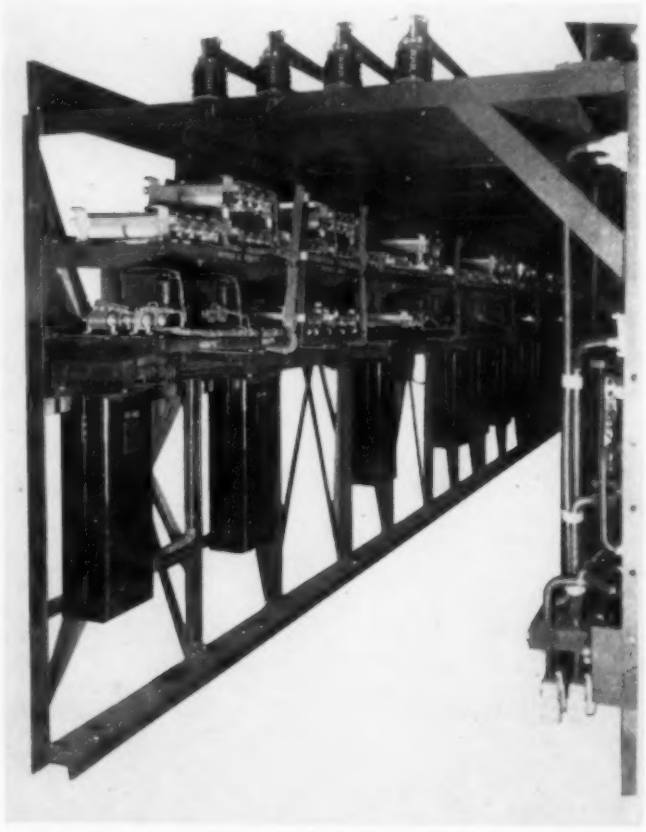


Figure 7 — A-c combination magnetic starters and a-c bus mounted on rear framework of d-c auxiliary control were used on a reversing blooming mill.

The plastic case air circuit breaker combines the function of an interrupter and a motor circuit switch, but for the moment, attention should be limited to its role as interrupter. This device enjoys a bonafide interrupting rating by well established standards which is equal to 15,000 rms amp. When used in

*Numbers refer to Bibliography at end of article.

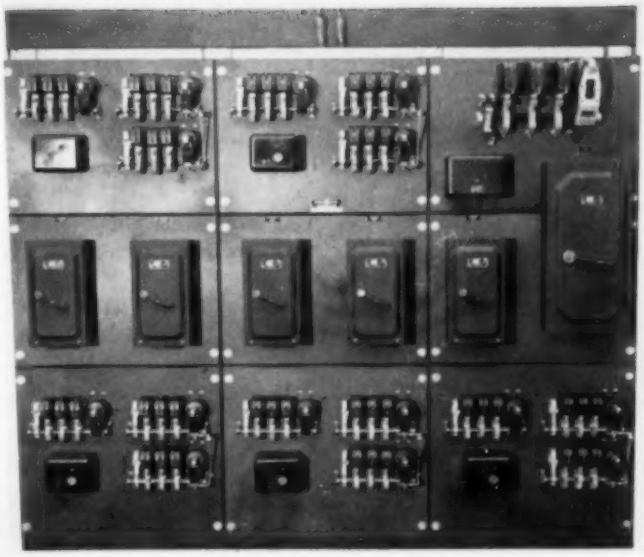


Figure 8 — The open-type, group-assembled combination a-c magnetic starters for soaking pit motors show enclosed air circuit breakers.

combination with magnetic starters, this device also can take advantage of the added impedance of the starter and up to and including NEMA size 3, it is difficult to produce a short circuit current level *through* the starter in excess of the interrupting capacity of the breaker. This fact, in itself, would apparently recommend the breaker for this type of service at high values of available short circuit current, but again the ever present time factor causes us to evaluate the energy let through by one of these breakers. Admittedly, these breakers trip and obtain a current zero in a short time, ranging from three-quarters of a cycle to one full cycle, but due to the fact that they pass short circuit currents during that time, limited only by the impedance of other circuit elements, the relative I^2t "let through" by the plastic case breaker is much larger than that permitted by the NEC fuse. A typical example is shown in Table I.

TABLE I

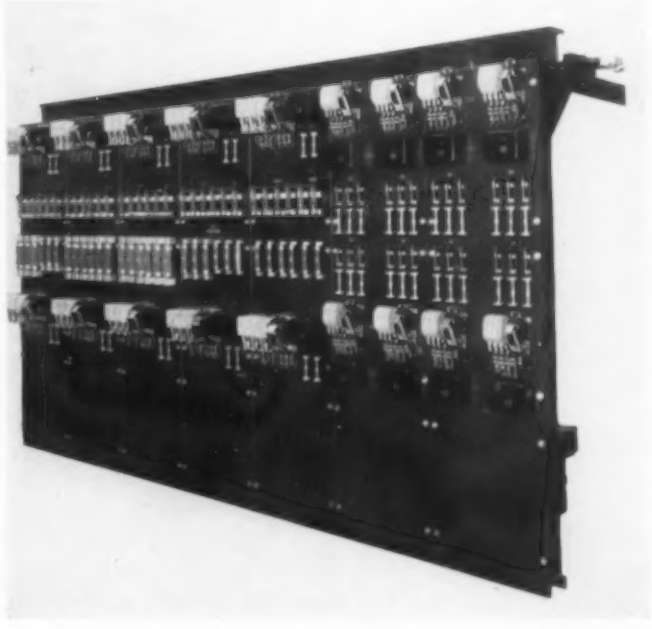
HP rating of starter 440 volts	ACB performance on 25,000 amp circuit		Fuse performance on 50,000 amp circuit		Ratio of ACB to fuse I^2t values
	Amp rating of ACB	Average I^2t in thousands	Amp rating of NEC fuse	Average I^2t in thousands	
7½	25 ATB	528	35	91	5.80
10	35 ATB	375	45	64	5.85
25	70 ATB	715	100	42	17.00
30	90 ATB	778	125	64	12.20
50	100 ATB	1,041	200	138	7.55

Notice that the available power supply for the circuit breaker performance was 25,000 amp compared to the 50,000 amp available power supply for the fusible starter. From this actual test data, it can only be concluded that by accurate measurement, the amount of destructive short circuit energy passed by air circuit breakers is considerably larger than that permitted by fuses, and it is therefore obvious as to the relative amounts of damage to be expected under short circuit condition. It should be made clear that the fuses used in the tests, which provided the data in Table I, were NEC non-indicating, non-renewable fuses and not the recently introduced low voltage current limiting power fuse.

Look at the physical evidence of the equipment used in tests which supplied the above data. It may be interesting evidence to examine pictures of the ravages caused by short circuits in low voltage a-c starters. Figure 4 shows a 30-hp, 440-v combination magnetic starter after it had been subjected to a short circuit established at the outgoing motor terminals of the starter, and available power circuit calibrated to give 25,000 amp short circuit. The plastic case air circuit breaker did establish and hold a current zero, but notice the upper lefthand corner of the breaker case is completely shattered; the leads between the breaker and the contactor are badly distorted; the flexible shunts of the magnetic contactor and the arc chutes are badly distorted by magnetic forces, and an internal arc-over caused considerable scorching inside the case, and there is evidence of some flame having escaped from the case. The contactor was slightly welded. A similarly rated combination starter is shown in Figure 5, except the branch-circuit-protective device is a fusible motor circuit switch. This combination was subjected to an available short circuit current of 50,000 amp. The test report says "sparks around the door with a moderate amount of smoke. All fuses blown." The contactor did not weld and from the general appearance of this starter one can only draw conclusions to support what was stated earlier in this paper as to the ability of the fuse to protect starters.

Back-of-panel wiring also suffers from the magnetic forces exerted by the conductors when a short circuit occurs. Figure 6 is a typical example of what happens in a control center assembly of combination magnetic starters after short circuit tests. Note the generally deranged power circuit conductors which were neatly lashed together with heavy twine before the tests were made. The upper combination starter, marked "X3", was a NEMA Size 4

Figure 9 — Open-type, group-assembled combination a-c magnetic starters for mill a-c auxiliaries. The fuses and knife switches provide motor-branch-circuit protection.



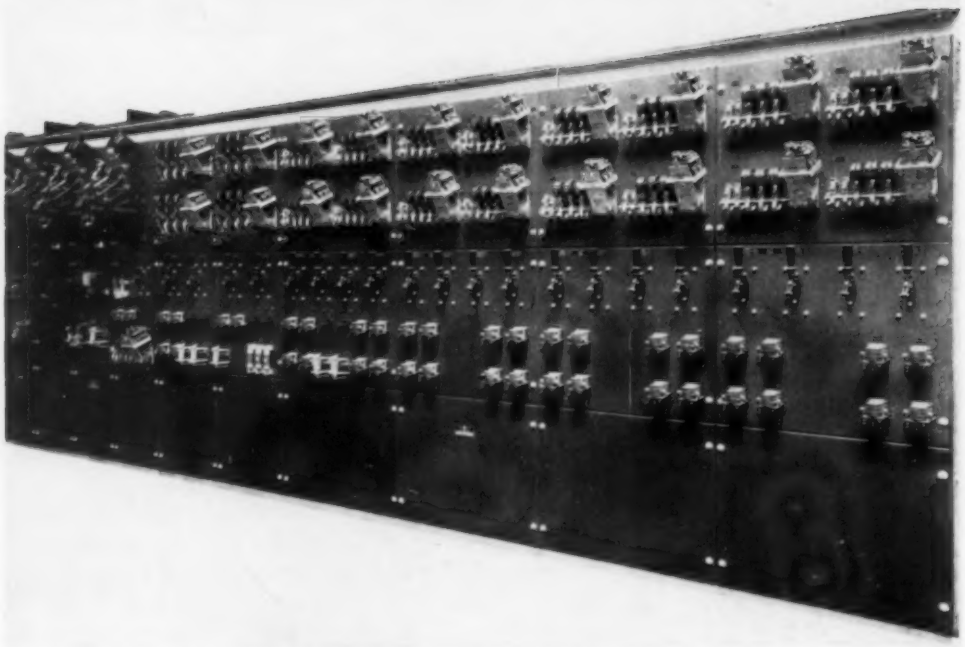


Figure 10 — A-c auxiliary control for a 3-stand, tandem cold strip mill shows d-c operated a-c contactors in combination with induction, thermal overload relays and dead-front, manual, knife switches.

starter and the lower, marked "W3", was a NEMA Size 3 starter, both protected by plastic case breakers on a circuit whose short circuit duty was 15,600 amp.

This paper proposes not to take specific sides with the type of interrupter used to provide the function of short circuit protection to the combination starter. The market place affords the availability of combination starters using both types of interrupters and the engineering facts here cited are for the purpose of assisting users in making a sound choice.

For starters NEMA Size 4 and larger, the larger power air circuit breaker is indicated for the protection of combination magnetic switches. The reason for this is twofold, first; the NEC fuse loses its current limiting ability with the larger size fuses which would be required for these starters and, secondly; the magnetic and thermal sturdiness of the larger starters is much better able to stand up against the let-through energy of the larger breakers.

MANUAL MOTOR CIRCUIT SWITCH

A motor circuit switch, by definition, must be rated in horsepower and capable of interrupting locked rotor current of a motor corresponding to its horsepower rating. Present day manufacturing standards provide motor circuit switches with horsepower ratings up to and including 50 hp, 440 v. Above this rating, switches which are used for disconnecting and isolating purposes are rated in amperes. Whenever a motor circuit switch, be it rated in horsepower or amperes, is not capable of interrupting the stalled rotor currents of the motor with which it is used, it is recommended that the switch be plainly marked "do not open under load". This is an NEC requirement. Since the interrupting ability of some of the larger motor circuit switches rated in amperes only may have definite limitations, it is not an uncommon practice to find the equivalent of a magnetic contactor with its blow-out coils and arcing structure arranged for manual operation instead of magnetic operation, thus paralleling in the disconnecting means an interrupting capacity virtually equal to the magnetic contactor in the combination magnetic switch.

The low voltage air circuit breaker of the plastic case variety besides being a good interrupter for short circuit protection is at the same time a motor circuit switch well capable of interrupting locked rotor current. Thus, the combined function of short circuit protection and a manually operated motor circuit switch are wrapped up in one device in the case of the small air circuit breaker. The only point in the critical appraisal of the elements of this combination magnetic starter, which should be called to your attention, is the inability by visual inspection to tell whether a plastic case breaker's contact tips are open or not. On the contrary, each pole of a modern motor circuit switch or a manually operated contactor can easily be checked for the position of its contacts even with the fuses in place.

Figure 11 — Group of ten totally enclosed, a-c combination magnetic switches, with externally operable, dead-front knife switches at right and left sides.

ENCLOSURES

The requirements for enclosures to meet individual needs vary widely. Dust, water, corrosive and explosive fumes and other adverse ambient conditions are well taken care of in existing cases. However, with the auxiliary drive and its control as an example, there are a great many installations of steel mill control in which no individual enclosures are used at all. Usually, however, the control is set apart in a room which is reasonably clean and in the more modern installations, very clean and air conditioned. In such locations, are found large group assemblies of open type combination a-c starters, which method seems to be the predominating method of installation as far as location is concerned. The individual enclosure, to provide safety to personnel, loses some of its significance in the control room type of installation for it is presumed that only authorized persons and then only those familiar with the risk involved will have access to or be in close proximity to this equipment for the purpose of maintenance and inspection services.

INDUSTRY SPECIFIED VARIATIONS

All of the preceding analysis has been solely for the purpose of establishing a benchmark of minimum, functional specifications of an a-c combination magnetic starter. It could form the basis for initial consideration by the proper committee within the Association of Iron and Steel Engineers responsible for electrical standards. (Editor's Note: A subcommittee has just been organized to study this problem with H. H. Angel, Bethlehem Steel Co. as chairman.) One of the premises of this paper stated the tremendous number of varieties of equipment which manufacturers have been asked to produce to accomplish essentially the same end result. To what extent has the electrical industry met those different requirements?

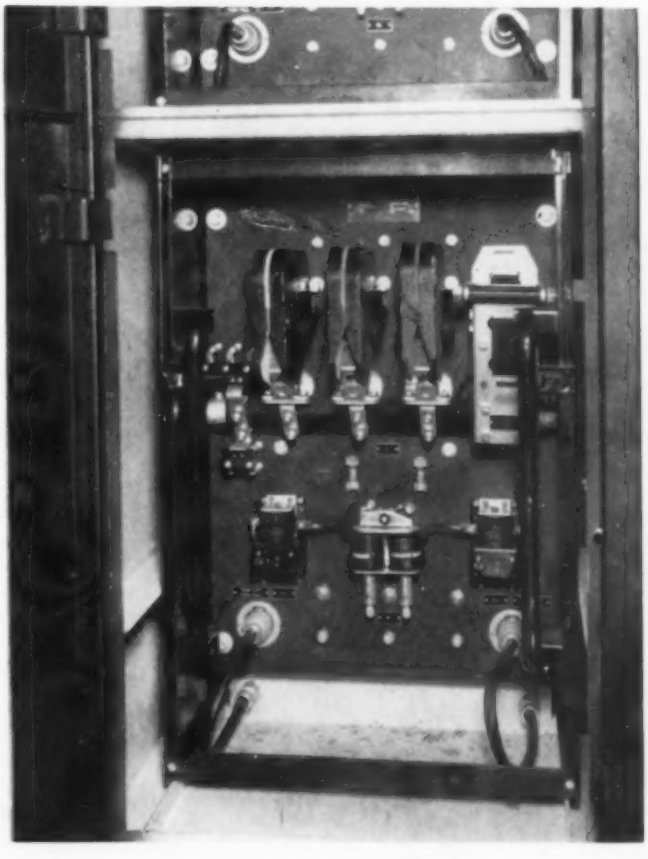
It is recognized that high grade, and respected engineering talent in the steel industry has had great differences of opinion concerning the basic building blocks of a combination magnetic starter.

An early method of treating the a-c combination starter problem is shown in Figure 7. Here standard fusible combination magnetic switches in NEMA Type 1 enclosures are mounted on the steel framework associated with a factory assembled d-c auxiliary control. A bare tubular a-c three phase horizontal bus can be seen running through clamp type supports directly above the a-c starter. Figure 8 shows a different method of treating the same problem. Here the a-c combination starters are made up of components assembled on open type insulating bases for group assembly. The conventional a-c contactor is open and is used in conjunction with a resistive type of thermal overload relay. The motor-branch-circuit overcurrent-protection is provided in this case by front-of-panel mounted, enclosed air circuit breakers.

Continuing the group assembled idea using open type components on insulating bases, attention is directed to Figure 9 in which standard a-c contactors and resistive type thermal overload relays are assembled in combination with open knife switches. These are distinctly isolating switches and cannot be looked upon as motor circuit switches capable of interrupting locked rotor current. Motor-branch-circuit overcurrent-protection is provided by NEC fuses rigidly held in high pressure clamps. Somewhat similar to the arrangement in Figure 9 is the group assembly shown in Figure 10. Particular attention is called, however, to the fact that these are d-c operated a-c contactors and overload relay protection is provided by the more expensive, ambient compensated induction thermal overload relay. Special attention is called to the fact that the disconnect switch is now dead-front and operated by the vertical handle shown in the horizontal row directly between the magnetic contactors at the top and the induction thermal overload relays at the bottom. Those dead-front switches, however, are operated from the same location as the live-front contactors and overload relays. Furthermore, they are not motor circuit switches, but are merely isolating switches, consisting of remotely operated knife switches mounted in back of this panel. In the particular instance of the panel shown, there is no motor-branch-circuit overcurrent-protection given to the individual starters.

The apparent popularity of a remotely operated

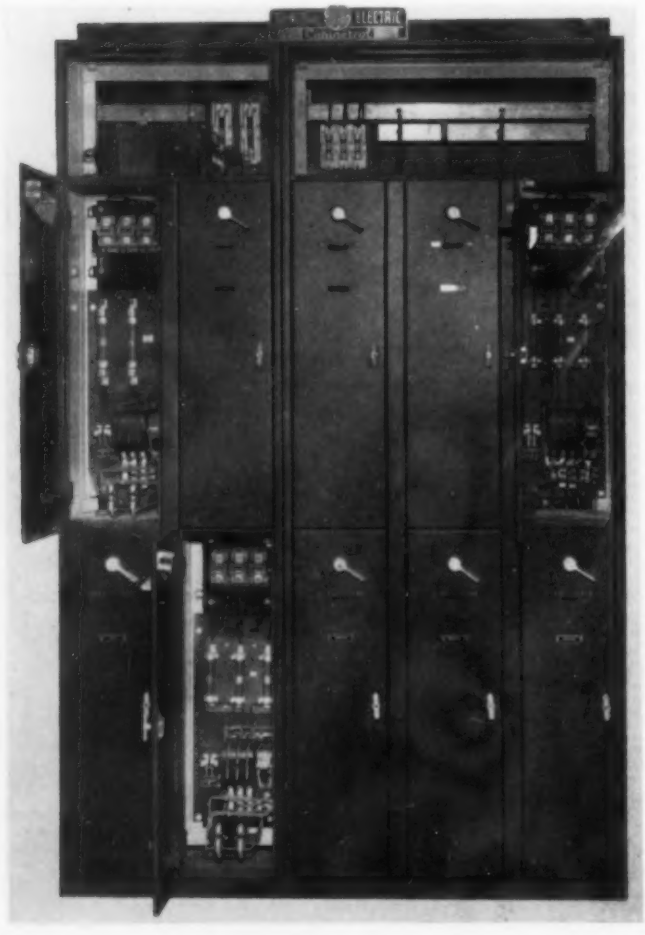
Figure 12 — Draw-out a-c motor starter is rated 200 hp, 440 v, with instantaneous and induction, thermal overload relays. Also shown are control circuit cables with removable connectors in each lower corner of panel, which is used with a 5-stand tandem cold strip mill.



dead-front isolating switch takes on a new aspect in the construction shown in Figure 11. The whole group assembly of ten combination magnetic starters shown here is enclosed in a NEMA Type 1 enclosure. The magnetic contactors and relays are behind the double doors in the front of the enclosure, whereas the operating handles for the dead-front isolating switches are mounted on a rigid steel panel strip which forms a part of the front of the enclosure. This type of construction carries the dead-front principle to the contactors and relays as well as to the isolating switches. Again, in this instance, however, no short circuit protection is given to the individual motor branch circuit in this assembly.

The draw-out idea, so firmly established in the low voltage, large-power air circuit breaker field, has had its counterpart in the control industry. Where continuity of service is paramount, the draw-out a-c motor starter may be warranted. The speed with which one starter can be entirely replaced with a spare equipment is obvious. In Figure 12 is shown a magnetic starter which consists of a 3-pole contactor mounted on an insulating base together with two induction thermal overload relays and two instantaneous overcurrent relays. Apparently in this instance, the interrupting ability of the contactor was high enough to cope with whatever short circuit values were expected, and the contactor performed

Figure 13 — Motor control center contains ten combination a-c starters, each with motor circuit switch and NEC fuse for short-circuit protection. Horizontal power bus is at top.



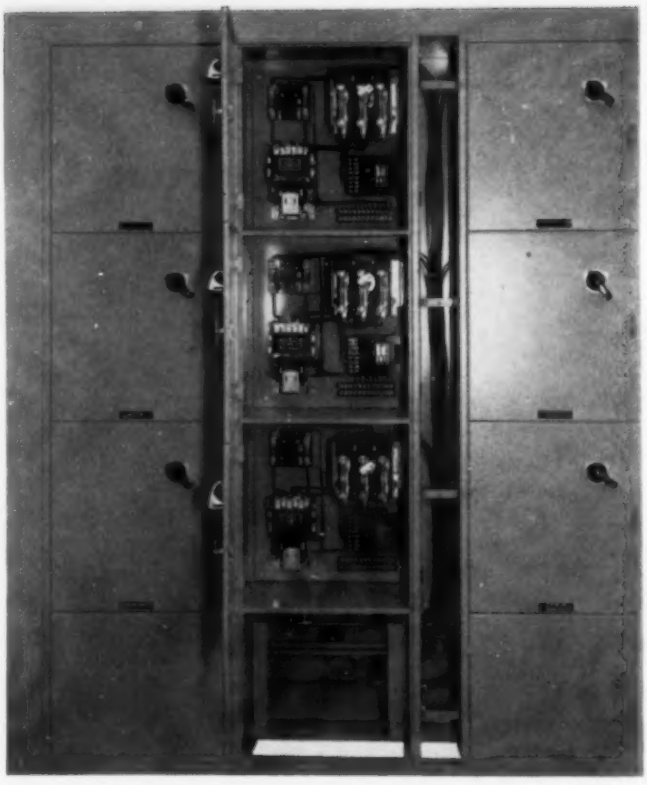


Figure 14 — A-c control center shows nine NEMA size 2 combination starters (three with doors open). Power bus is at bottom. Cover is removed to show wiring accessibility.

a dual role of motor starting switch and short circuit protective device. The complete arrangement was mounted on a chassis which could be slid in on guide rails. The main power circuit to and from the starter was made by the typical draw-out connection construction familiar in the switchgear art. The control circuits, however, were disconnected by special connectors on the ends of flexible cable, one of which may be seen in each of the lower corners of the figure. Later models have abandoned the flexible cable idea and now disconnect the control circuits as well as the main power circuit. The motor control center idea spread rapidly through all industries during the last war, particularly in the chemical process industry. The control center idea is simply the boiling down into a partly standardized system what had been going on for years in many industries with various ramifications. Figure 13 shows various sizes of combination starters assembled as a motor control center. The horizontal bus extends through the top compartment and each motor-branch-circuit is fed from this bus through the individual combination motor starters. The particular motor control center shows fusible motor circuit switches, externally operable, used as the short circuit protective device, and conventional a-c contactors with thermal overload relays as the motor-running-overcurrent-protection. Recently, engineering progress in the control center art has brought about greater space economies; completely front connected and front accessible devices; more accessible facilities for incoming and outgoing wiring connections; better segregation by steel of each combination starter from the

other; and a universal operating handle for the motor-branch-circuit protective device, be it plastic case air circuit breaker or fusible motor circuit switch. The newer control centers are capable of being installed against the wall or back to back with each other. A typical view of the control center especially designed for steel mill service is shown in Figure 14. The liberal wiring gutter shows how conductors are brought to and from each individual combination starter from a common 3-phase bus, which in this instance is in the bottom compartment. A control center of a similar construction is shown in Figure 15, with the exception that plastic case circuit breakers have been used as the short circuit protective device and the overload relays consist of two individual ambient-compensated induction thermal overload relays per each starter.

Space would not permit the discussion or pictures of many additional varieties, but it would seem evident from the foregoing pictorial display that there is no fixed pattern or prescription for a-c motor starters.

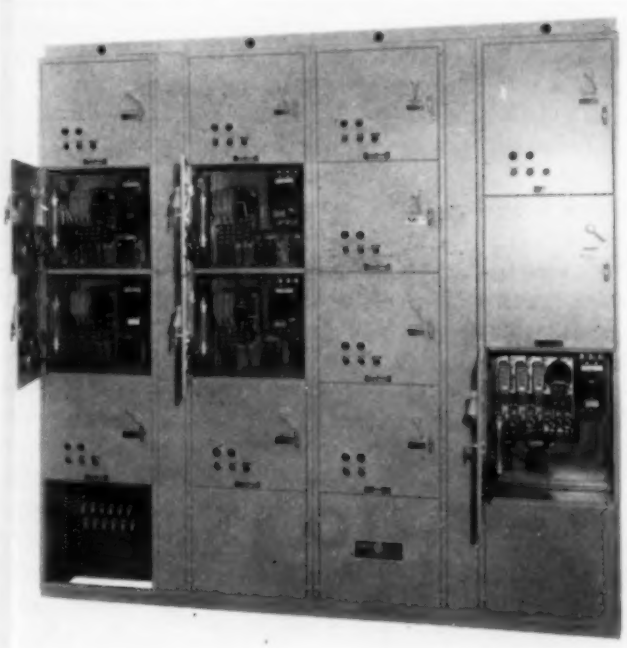
CONCLUSIONS

In conclusion, it is suggested that this is a most worthy subject for the AISE Standardization Committee to review. A beginning could be made by developing such pertinent subjects as are provoked by the following questions:

1. What constitutes good overload relay protection to the a-c induction motor used on steel mill auxiliary and accessory drives?
2. To what level of available short circuit current should the general purpose combination starters be designed?
3. Why should NEMA Size 2 contactors be considered the minimum in steel mills when currently available NEMA Size 1 contactors outperform the older NEMA Size 2 contactors?
4. If 600-v a-c contactors are frequently subjected to say 1200 v during the plugging of an a-c wound rotor motor, and favorable operating experience condones this practice, why is it necessary to call for wide pole spacing on 440-v a-c circuits in steel mills?
5. With the trend toward group assembled control, such as the control center located in a reasonably clean location, what should be the type of enclosure used?

These are questions selected at random, and they are respectfully commended to your attention. All of the industry will benefit by whatever standards the AISE can develop.

Figure 15 — A-c control center shows group of combination starters with air circuit breakers as motor-branch-circuit protective device.



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DISCUSSION

PRESENTED BY

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GEORGE NICHOLSON, Electrical Engineer, Bethlehem Steel Co., Steelton, Pa.
J. W. DEIMLER, Assistant Maintenance Supt., Alan Wood Steel Co., Conshohocken, Pa.
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GEORGE VAN ARTSDALEN, Superintendent Maintenance, Henry Disston's Sons Co., Philadelphia, Pa.
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L. J. GOULD, Chief Engineer of Construction, Bethlehem Steel Co., Bethlehem, Pa.
E. H. ALEXANDER, Manager, Commercial Engineering Div. Control Division, General Electric Co., Schenectady, New York

M. B. Antrim: When talking about such a thing as standardization of control, we get into the situation of which came first, the chicken or the egg. It is very difficult to find a place in which to start.

Mr. Alexander said that there are many obvious advantages of standardization, and upon thinking that over, there are certain measurements of these ad-

vantages which we, who are charged with the operation of these devices first think of whenever a new piece of apparatus is presented to the industry. There are six of these items: Correctness of application, durability, ease of repair and installation, stock necessary for repair, sources of supply, and, last of all, first cost.

The reason first cost is last is quite apparent. It is due to the fact that, as we all know, labor costs have risen. Efficiency in production and maintenance is rapidly coming forward with great emphasis. Due to the comparative low cost of a-c control as compared with the labor costs of installation and maintenance of these controls we feel "first cost" is rightly last.

The first of these items, the correctness of application, is a fairly simple thing, but it is also one which can be and is involved in the high maintenance cost of a-c control. One of the most vicious applications which we know of involves a very simple device. It is the door hoist. An electrical door hoist in a mill, rising in one, two or three sections, and perhaps driven by a three-quarter horsepower motor is a fairly common installation. A man comes to operate the door, presses the button; the door goes up six inches and stops. He presses it again and maybe the door goes up a little more. Alongside the button is a black box. The man hears a little "ping" in the box so he presses the button he sees on the face of this box, and again presses the operating button and the door goes up a little more until another "ping" is heard. He then presses both buttons. So you see, sometimes an overload acting as a fuse is a good thing.

In the case of durability, we, at Lukens use a size 2 starter—not entirely from that viewpoint, however. We find 90 per cent of our applications for squirrel cage motors can be taken care of by the application of the size 2 starter. That means that our spare parts, our instructions to our installation and maintenance personnel, and all records covering these controllers are simplified, due to the fact that we have only one size of starter which is arranged in more or less the same fashion throughout the whole plant. On the subject of durability, we naturally expect that progress will make these starters more durable in all sizes. We are greatly against the policy that cheapness and less durability is to be the thing. In other words, "make it cheaper and replace it quickly and easily" does not make sense where production delays can cost real money. We would rather buy equipment that lasts.

The more equipment that is standardized, the more easily our personnel are trained to take care of that equipment in an efficient manner, thus producing the lowest labor cost, also the less stock we will need to take care of these installations. Since there are a great number of control manufacturers, each of which makes starters from a size double "O", up, a representation of one of each of these in a plant will produce a tremendous stock of spare parts that must be kept on hand for insurance purposes, to make repairs to those starters. This is not an efficient use of money which we must also consider as well as an efficient use of personnel.

The fifth point, the sources of supply, is self-explanatory. As you all know, during the last war, everyone took care of the old customers first. Such a thing can happen at any time and it is therefore well to have more than one source of supply.

And last, the first cost, I believe we have already explained.

There are a few other considerations which may be talked about, and they are very tough problems to solve, when it comes to the standardization of any type control. Standardization must not hinder progress. Any standardization is very likely to hinder progress, because people having standardized their equipment, are loath to change it. So, any progress made on a standardized line must come in the natural course and fit into the standardized line with the least possible disturbance.

I, personally, have one suggestion I would like to offer to all of the manufacturers of control, in regard to changes in design. The changes in design which are ordinarily made, occur, according to my opinion, as a result of some man way back at the factory getting an idea. He figures something out and puts something different into the controller; changing a spring length, or a mounting dimension or the shape of a contact or some such item and then no one says a thing about it! Then, when you order a renewal part, you get the wrong things. It would therefore seem to me that any small change of any nature in any part should be publicized thoroughly and in detail to all the users of equipment.

I should again like to plead for the cause of standardization, for two reasons, the efficient use of the money we invest in spares, and the efficient use of our personnel in the installation and maintenance of this equipment.

C. L. Eichenberg: In presenting this paper on the standardization of low voltage alternating current starters, Mr. Alexander has expressed the impartial views of a control manufacturer who has had an opportunity to evaluate the performance of the various components which comprise these starters and their suitability for application in the steel industry. He has also been able to study the details of specifications for control as presented by various steel mill customers. In many instances these specifications were found to vary widely for similar applications, probably due to a difference of opinion on the part of the customer as to the ability of the control constituents to perform satisfactorily.

The performance characteristics of the various control components were very thoroughly analyzed by extensive tests in the manufacturers' laboratories, and the conclusions agree very closely with results obtained on similar equipment in steel mill service at the Bethlehem Plant. Briefly, some of these results are as follows:

1. The plastic case circuit breaker is not adaptable to service in our plant because of the high level of short circuit capacity available on the low voltage network. This can best be appreciated when one considers that we have in service, two networks of 4500-kva capacity, six of 3000-kva capacity, plus a

large number of 1500 and 1000-kva banks all at 220 volts.

2. The NEC fuse does an acceptable job of fault interruption in the smaller sizes, but considerable trouble has been experienced in using the higher rated fuses due to heating under load and complete destruction when interrupting heavy faults. Perhaps the current limiting fuse is the solution to this latter problem.

3. The motor disconnect switch could be improved considerably by the addition of an arc interrupting chamber on those sizes which cannot rupture stalled rotor current. On sizes 100-hp and larger, we have standardized on the 25,000 or 50,000-amp interrupting capacity circuit breaker with instantaneous protection in order to eliminate troublesome fuses.

4. There is a definite need for a rugged thermal type overload relay with ambient temperature compensation.

5. The integrated type of multi-motor control center has a definite place in the steel industry, and results in considerable saving in installation costs over the older built-up type of control.

There are a number of advantages to be gained by the steel industry by the formation of a set of standards to cover low voltage a-c motor control. Among these advantages are:

1. An opportunity to obtain first hand knowledge of the experiences of other steel plants in the use of various control components.

2. The development of specially designed control apparatus to meet steel mill requirements which will be available from all manufacturers of such equipment.

3. A reduction in cost of control to the customer by elimination of special engineering now required on many projects. This should also improve the delivery considerably on large integrated jobs.

4. An opportunity to obtain the full measure of performance from the control, because of extensive tests made to prove the soundness of its engineering. Certainly these advantages should be ample inducement to the Association of Iron and Steel Engineers to sponsor the standardization of a-c low-voltage starters.

George Nicholson: I am wondering if the problems of each of us here tonight may not be somewhat different, and for that reason I am afraid that it will be quite a task to evolve even a minimum amount of standardization, although I believe it would be a step forward in the right direction, if a minimum amount of standardization could be accomplished. At the Steelton plant we use circuit breakers to protect our feeder circuits, and fused disconnect switches, or in some instances, we use the so-called plastic type circuit breakers ahead of the low voltage a-c starters; our results have been very satisfactory. In fact, we have very little trouble. In a very few of the other steel plants, the conditions are no doubt different, and probably their requirements would necessarily have to be somewhat higher and, therefore, naturally more expensive.

I, also, noted that Mr. Alexander, in his paper mentioned the use of pressure clamps on fuse clips. I think the use of pressure clamps, where possible, is good practice, based on our experience with them, and should be adhered to. The importance of using clamps was quite recently impressed upon my mind, during the recent steel strike. One of our switchboard operators, while cleaning a rotary convertor, had to start and stop it several times in order to get at all of the commutator slots, and as he opened a fused disconnect switch while stopping the machine, the middle fuse dropped out of its top clip falling over against one of the other poles, causing a short circuit. Our feeder circuit breaker cleared the fault, although the door of the switch box was blown open, and the fuse was found laying on the floor. The operator's injury was very slight, only a burnt hand, compared to what it might have been, had his face been in front of the box. On examination, we found loose fuses in two additional switchboxes which were mounted beside the one which had failed. From this so recent experience I can see that it would be a wonderful start to standardize by solving the fuse clip heating problem.

As far as the enclosures are concerned, we have some load centers, and, also, a large number of individual starters, scattered throughout the plant. It has been our policy to specify NEMA type 1-A enclosures, because from experience we find that in a steel plant that when the dirt, which is practically always a good electrical conductor, gets inside of an enclosure, it is just about impossible to get it out. You just blow it around without helping very much. The best policy is to try to provide an enclosure which will keep the dirt out in the first place.

I am also wondering if we do not already have a set of standards for low voltage a-c control, which is ample in most cases. I am speaking of the NEMA standards for steel mill duty control and not the Underwriters standards. As far as I know, it will be satisfactory in most cases. While we of the Steelton plant at the present time are having practically no major troubles of the kind mentioned here tonight by some of the other men, some of the other plants may have altogether different conditions and problems.

J. W. Deimler: The author has given a clear and concise statement of the purpose of each of the components of the a-c starter and has indicated some of the limitations of the NEC fuse and the circuit breaker. He has also given some indication of the problems which the design engineer has to cope with in designing the components of the starter, particularly the overload relay.

I was particularly interested in the discussion of the two types of short circuit protection which were normally used. We have used both types without perhaps quite as much concern as some of the other plants who are faced with the problem of higher short circuit protection. We have not had any cases where the whole unit has blown up, such as those shown by Mr. Alexander.

I am truly in accord with the general idea of the present day control grouping where you have a considerable number of motor starters to be controlled from one central location.

Perhaps Mr. Alexander did not have time to take into consideration the enclosure for the individual motor starter. I feel that if all the manufacturers allowed as much room in the individual starters as they do in the group control, we would be much better off. They have all introduced newer designs of motor starters in which the contact assembly is more compact, the overload relay has become smaller, and the case has become much smaller. You have a difficult time getting wires in some of the size 1 starters, particularly when using some of the neoprene-jacketed wires rather than the thermoplastic insulated wire the manufacturers use to make the standard connections in the starter. It is hard for a mechanic to work on the starter and do a decent job.

The problems which Mr. Alexander presented when discussing standards, should definitely receive a great deal of consideration before any final set of standards are established.

T. S. Novak: Mr. Alexander did an excellent job in analyzing the functions of the component parts of a combination a-c starter. His paper should remind us that many of the individual plant standards were formulated from the results of performances of starters made 15 to 20 years ago. Ten years ago at Sparrows' Point, nothing smaller than a size 2 starter would be considered. However, since the beginning of the past war, a large number of size 1 starters have been installed on motors up to and including 1½ horsepower. These starters have given good dependable service. Better service would not have been experienced if the larger size 2 starter were used. Starters with wide pole spacing are not used in this plant, very few flash-overs have been experienced between contactor poles, and it is questionable if any of these were caused by the electrical clearances on the standard magnetic switch. The starters are used on 440-v, 60-cycle, and 550-v, 20-cycle power.

It is believed that for a number of years the trend of all heavy industries has been to use 110 volts for the control circuit. This voltage is obtained from a separate source, or from a control transformer mounted in the starter. Some manufacturers of a-c starters consider the unfused, full line voltage as the standard control voltage. Perhaps if some of the control catalogues specified 110-v control starters, some of the so-called plant standards would be adopted as general standards.

George Van Artsdalen: The author points out the weaknesses of the first magnetic starters, but also shows the improvements that have been made over the years to make them the dependable and trustworthy servant which they are today.

Reminiscing a little, I can think back to the time when all a-c motors were started manually, either with an ordinary open knife switch or a more elaborate manually operated contactor enclosed in a cast iron case. All low voltage motors of 5-hp rating or more were started at reduced voltage to prevent line disturbances and to keep from imposing undue mechanical stresses on motor windings. One of the greatest advances in a-c motor application and control has been the design of motor windings to take the shock of full voltage starts; and the more liberal design of control to carry excessive current inrush at starting, yet protecting the motor by properly designed overcurrent protective devices. Where a very low maximum in horsepower (usually under 5-hp) was set thirty years ago, now ten times that horsepower rating and more is started at full voltage.

Standardization of control dimensions, enclosures, and ratings is very much in order and should be just as beneficial to industry as was the standardization of motor frames and dimensions, accomplished a few years ago.

It is felt that there is also a great field for improvement in overcurrent protective equipment as used in conjunction with a-c motor starters.

The original magnetic overload device, using an oil dash-pot for time delay, was satisfactory years ago, when nothing better was obtainable.

However, the introduction of the thermal overload device outmoded the magnetic type, as hydromatic drive did the Model T gear shift. Along with the development of the thermal overload type of protection came the development of induction type overcurrent devices for use with larger and more important equipment.

Since thermal overload protection has so many short-comings, in that many things govern its accuracy, such as different types of enclosures, ever changing ambients, and the like, it is suggested that the induction type relay be perfected in a lower price field. The only thing that permits thermal and magnetic overload protective devices to remain in use is the cost differential between them and the induction type device. The development of an accurate and dependable induction type over-current relay that could compete with thermal and magnetic devices, price-wise, is very much in order. Perhaps the induction-thermal relays which Mr. Alexander mentions is the answer. I have not had any experience with them as yet.

The five questions which Mr. Alexander asks in conclusion are well selected giving a lot of food for thought, and would probably be added to by any committee seeking simplification for standardization.

J. A. Cortelli: Mr. Antrim's remarks interested me very much because one of the first points that he mentioned was correctness of application, and too often when standards are adopted, control is specified according to a certain standard without fully considering the application.

For example, as Mr. Alexander pointed out, quite often the minimum sized contactor you specify or use is determined by the interrupting ability of the contactor and power available behind the contactor, and with larger blocks of power being available, as time goes on, it becomes much more important to fully consider the protective device that is going to have to do the job in case of short circuit. As Mr. Eichenberg mentioned, they are specifying in many cases special breakers with adequate interrupting capacity because of the large amount of power available behind the contactor.

The other comment that I would like to make is on the modern design of squirrel cage motors. The author mentioned the fact that the modern design of squirrel cage motors is going to a lower and lower

time factor where the motors will have less ability to absorb the heat that is put into them on installed conditions. In my opinion that is going the wrong way, because our problems are hard enough today in trying to design an overload which will not act as a fuse in case a short is on it, and it just complicates the problem and makes the problem a lot more difficult, if we have to design an overload which will take the motor off the line a lot faster in case of a stalled rotor condition.

Another remark I would like to make is use of magnetic overloads. They still have their place, in my opinion, because there are many times when it is much more important to keep something running, regardless of whether you are going to burn that motor out, than it is to take that motor off. I know there are many operations and many instances where the damage that would be done by the time down in a certain process would be a lot more costly than the burn-out of a motor, and the ability to re-set an overload in as short a time as possible makes it imperative at times to consider the magnetic overload.

In view of these special conditions on particular applications, I think that any standards that are established should be given full consideration before any set standards are set up, because it would be probably better to end up with different classifications of standards for steel mill applications rather than one fixed standard.

F. S. Horner: I do want to say that I would like to thank the author for bringing out into the open the fact that squirrel cage motors do have more than six times full load running current inrush. Unfortunately it seems to have been a fact that was ground into people's minds and has become a rule of thumb that a squirrel cage motor never takes more than six times its full load running current. Perhaps that was true for a while, but it is no longer true, and a great many people are going to have to be re-educated. It has been a fact that has not been brought to the front, very much.

W. R. Yorkey: Mr. Alexander stated in his paper that he presented what he did in an entirely exploratory manner and he asks the cooperation of the AISE in furthering standards, and it is in the same vein of thought that these comments are presented. I want to confine my remarks to only one point: that is, protection against short circuits. That seems to be rather important. Mr. Alexander showed illustrations of starters which had opened under short circuit, with considerable damage. Several of the speakers have mentioned the same things, and have pointed out that the possible short circuit currents may run to very high figures.

As doubtless many of you know, we have been manufacturing a-c motor starters with self-contained current limiting air core reactors for some time, which when combined with a high interrupting capacity contactor seem to provide a satisfactory method of handling high fault currents. So far these have been built for 2300 and 4160 volts, only.

The design is covered by Paper No. 49-117, presented by Mr. Leitch early in 1949, before the AIEE, and while the paper is concerned chiefly with high voltage applications, Mr. Leitch discusses the possibility of using the same arrangement on low voltages and the three concluding paragraphs follow:

"Low-voltage applications (Up to 600 volts):

A similar study was made of low-voltage systems with a view to determining the practical range of application of air-core reactors. The size and weight of the reactors themselves and their effect in reducing the voltage at the motor, particularly during starting, were the critical factors.

About 95 per cent of the activity in the low-voltage field is covered by motors up to 200 hp. In general, transformer banks are not larger than 3,000 kva, giving a maximum available kilovolt-ampere of about 50,000 at 6 per cent impedance. This results in fault currents of considerable magnitude on low-voltage systems, for example 65,700 amp at 440 v. By a study similar to that made in the case of 2,300 and 4,600-v systems, it can be shown that for maximum available fault currents in excess of 30,000 amp, reactors may as well be designed for an assumed infinite available fault current. This is comparable to the conditions found with high-voltage reactors where available kilovolt-ampere is in excess of 200,000.

Following the same procedure as in the case of high-voltage systems, it was necessary to choose a limit for the fault current. If 10,000 steady-state amperes is chosen, and similar limitations in weight and starting torque are accepted, it appears that the range of application would be 100 hp at 220 v and 200 hp at 440 and 550 v. The 10,000 amp limitation demands the use of controllers having rated interrupting capacities of 15,000 amp or better including the d-c components."

In other words, it would easily be possible, if the demand is there, to supply such a starter for low voltage applications. The economical limit seems to be 100 and 200 hp at 220 and 440 v, 60 cycles, respectively. We would like to know what the reaction of the members to such a starter would be.

H. M. Shuff: The idea of standardization is something that first of all your industry must want, and you must want it seriously enough that you are willing to get together and work at it. Sure, it poses a problem. The question of whether you are to use a high interrupting capacity device, or a low interrupting capacity device, or a large over-rated contactor, or a smaller one, comes all within the framework of your everyday problems. The question is, can you evolve a standard that will cover these and react to your advantage? If you can, it then reacts to the advantage, I am sure, of the manufacturers, as well as to you.

Unless, gentlemen, you can convince yourselves that this standardization is to your advantage, I do not think that you will make very much progress in evolving a real standard. On the other hand, if you are convinced and do go to work on the problem, I think you can break it up into possibly three groups. First, looking at the apparatus, you can develop a mechanical standard which may solve many of your problems. Secondly, you can evolve an electrical standard. And then, thirdly, it seems to me that there must be an application standard in order to determine where to fit the first two to that problem.

Now, if you work at it in that direction, it certainly seems to me that you can work out a general standard. I do not think it ought to be a general standard that ten per cent of the industry would use or twenty per cent would use. It would have to be the kind of a standard that 70 or 75 per cent, or possibly more would be glad to use. And by that I mean that you would use it generally and consistently.

Now, just one other thought, and that is the problem of the designer to meet your problems. I do not think we can reconcile two of the comments I have heard here tonight. On the one hand, we hear the need of maintaining a standard that does not change, and that makes your replacement problem easy. On the other hand, we know the designer's problem of modernizing his equipment as the art improves, as he meets everyday requirements, and as he supplies the demands.

Finally, I would again very much like to commend Mr. Alexander for bringing up this subject. I would certainly like to see the industry do whatever they can. If they are convinced they want a standard, and will make it known, I am sure there will be no reason at all why the manufacturers and the industry can not and should not work together to get one for their mutual benefit.

L. J. Gould: I am not primarily an electrical man and I understand just enough of what Mr. Alexander has said to realize it took plenty of courage to do it. I also want to congratulate the Philadelphia Section papers' committee in taking as important a subject as this and bringing it out where the rest of the iron and steel engineers can take a look at it. I can think of no better way for a standardization project to start than the way this started tonight.

As you know, it is the job of the AISE Standardization committee to decide whether it will try to set up a standard, and who will do the real work. This subject seems so important to me that if we can get the papers, we will circularize the Standardization committee by mail.

The one thing that occurs to me as an engineer who has to sign his name to papers involving expenditures for control, is that there is a kind of "Alice-in-Wonderland" logic connected with the whole subject. For instance, there are the controls for simple things, such as machine tools. If you have one in your cellar, you use a light switch. If you put the same tool in the steel plant, you spend $400 for the control. In spite of Mr. Antrim's comments, I think there is a lot of money to be saved. Many general machine shops that use the same kind of machine to cut the same kind of steel will accept machine tool manufacturer's recommended control and have little trouble with it, but do not try to sell it to any of the steel plant electrical engineers! It is too cheap!

There is only one certainty we have about control. That is, if one of our plants will set forth a definite method of controlling a particular motor on a particular job, then you can be sure that no other plant will have anything to do with it. I am also sure no other corporation would want any part of it.

I know all of the men in our company who are responsible for electrical specifications and (although I will not admit it to them) I have a high respect for their honesty and technical competence. It is necessary only that they and their equivalents in other companies think the problem out together. We will save just a little money and a lot of sleep.

E. H. Alexander: I can only agree wholeheartedly with Mr. Antrim on the order of importance which he established for control features. He placed correctness of application, first, and cost, last. There can be no disagreement with that, because, after all, the others are in diminishing proportions.

I do think, however, along with standards of a basic nature, there may come a time when we can have correctness of application first, and paramount with some benefit to be extracted on the other end of the line, in ultimate cost.

His experience on the size 2 starter was interesting to hear, and of course, it lines up with a great many other steel mills that have NEMA size 2 starters as the minimum standard.

It was refreshing to hear him express that he looks upon control as not an expendable device, and that one should not get inexpensive and inadequate components which he expects to blow up and replace. The down-time, alone, or cost of the same, would far exceed the capital investment in better control.

Standards must not lag behind progress. That was another note he sounded. How heartily I agree with that.

Mr. Eichenberg hit on something I really tried to cover in the paper. He reminded me of something about the National Electrical Code I would like to point out. He says NEC fuses fail at higher ampere ratings. The National Electrical Code fuse loses its interrupting ability markedly above those sizes required for NEMA size 3 starter, and in its place he told you he uses an adequate large-power circuit breaker. That is good, because as the contactor gets bigger, its ability to withstand the "let-through" current makes an ideal application. There is room for an improved motor circuit switch. There is no doubt about it. Today we stop at 50 hp with a motor circuit switch having an interrupted capacity rating. Above that level have been improvised things such as contactors operated by hand, instead of a magnetic coil, but there is a great deal of room for improved interrupters, above 50 hp.

Mr. Nicholson referred to pressure clamps on fuses. The ability of the fuses to interrupt at all depends on its staying within its own clips, but pressure clamps can be a snare and a delusion. I would like to call your attention to several popular types of clamps we have used, and others used, which have a screw, driving a wedge of some fashion to tighten the clamp of the fuse in its clip. With these beware, because the cold flow and stretching of metals will create a false sense of security. Recently, improvements in clips for fuses have been such that the follow-up of a backing-up spring is much to be preferred over a screw clamp joint, because they will loosen and stretch. I strongly recommend that type of clip for your consideration.

Also, enclosures were mentioned. The greatest protection I know of for dirty atmosphere is an en-

He said NEMA standards are good. We think so,

too. But, for your industry and applications, it is my feeling they do not go far enough in qualifying the conditions under which control is used. They are an excellent prescription for appraising performance, but they do not appraise the kind of circuit you are going to put them on, so that is why I think there is this need for going beyond, into the utilization code, if you want to call it that, of these devices.

Mr. Deimler brought up an interesting point, and that was the extremely small enclosure that some of these standard starters have been put in. There must be adequate room to wire these devices because we can not expect people to even service or maintain devices which they can not get at.

I was glad to hear from Mr. Novak that his experience with 1½-hp motors handled by size 1 starters was good. I think it should be good, and will continue to be. He brought out another note that struck something in my mind, and that was that wide pole spacing in itself is not necessarily the only solution for flash-over. That is, under certain conditions flash-overs might have occurred with any reasonable pole spacing due to transient voltages beyond those expected to be handled in that classification of equipment.

Mr. Van Artsdalen mentioned in-rush currents, as did also Mr. Horner, and I will amplify Mr. Horner's comments later. Yes, overload devices have been improved, as Mr. Van Artsdalen said, and they need to be improved more. His remarks about the induction type overload relay, I presume, referred to a magnetic induction type; not the induction disk type common in switch-gear practice. I am sure he meant that, for the latter type has no "memory", and can not integrate heat units, or "remember" what has gone on before. So I presume he had in mind one with a thermal memory.

Mr. Cortelli said I brought out in the forefront, that squirrel cage induction motors of today are not capable of withstanding the stalling time that they used to stand. That is right. I would say that inevitably the design trend is to even shorter times. We can not stand in the way of engineering progress. I know what comes immediately to your mind is that in this physical machine that has an output shaft, you are not getting as much iron and copper and steel, and what have you, that makes it up. That is right, but that is engineering progress, and I refer back to my comments, that if it does what the name plate says it is supposed to do at the temperature rise it is supposed to withstand, and so on, we can not stand in the way of that progress. It is difficult for the control designer to try to catch up and match these thermal speeds. The only hope may be to take the motors to even higher temperatures, during a stall, and then we will have a little better break on the time characteristics of overload relays.

He mentioned also that the application rules the day. That is right and checks with other comments by Mr. Antrim. We are not trying to belittle the adequacy of application and substitute therefore, a code of standards.

Now a word about the higher inrush currents that Mr. Horner mentioned. Yes, transient starting currents can be very high. By transient starting currents I mean those currents which have a value far in excess of the 3-phase steady state locked rotor current. Polyphase squirrel cage induction motors have locked rotor current values ranging all the way from 4½ to 5 times normal current up to 10 or 12 times normal current, depending on the design of the machine, with approximately 6 times normal full load current as a good average for the general purpose motors. When such motors are switched onto an a-c system, it must be remembered that conditions will obtain which will cause asymmetrical currents of varying degree in two of the phases with one phase usually more severe than the other. This is due to the fact that a motor has inductance. Theoretically, transient current can be about twice the normal locked rotor value in the worst phase, which means that even with an average motor, one pole of a magnetic contactor may have to handle twelve times normal motor current for a short time during starting. These high transient currents may work a hardship on contact tips at the instant of "kissing", for in this condition the build-up of contact tip pressure has not taken place and there might be a tendency to weld on these high currents. These are the problems of design which the control designer must face.

Starting a motor from rest does not necessarily produce the highest transient. Very often a reduced voltage starter having an open circuit transition point between the "start" and the "run" contactor, may produce severe transients due to connecting a motor with preconditioned iron to the power supply circuit. I have seen installations of reduced voltage starters, applied for the purpose of limiting the amount of current drawn from the line during starting, produce transient current on transferring from reduced to full-voltage connection as much as 16 times normal full load current at the instant of transfer. Thus, the very purpose for which reduced voltage starting was indicated was defeated. All of these phenomena are well known in the electrical engineering art. They are of special interest to the control designer for his devices must cope with the situation.

Mr. Yorkey, in presenting Mr. Leitch's paper, is virtually saying to me; "Ohm's law of the a-c circuit can not be denied." Who am I to disagree with that?

Of course, air core reactors which have been used on high voltage motor starters, can be stepped down without doubt to the low voltage range. The limitations put on, I think are brought about by the tolerable voltage reduction, and may be reduction in torque, or it might be physical size; I am not too sure. But I will say that it is in use, in switchgear practice right now. I know where there are some low voltage air core reactors on a load center unit substation where a very small feeder circuit originates from a very high capacity bus, and the economics of providing a full capacity breaker for that set-up are not warranted. Therefore, air core reactors have been used for that purpose.

Last but not least, it was heartwarming to hear from Mr. Gould and to think perhaps that the presentation of this paper tonight may have started and provoked some thought for the AISE standards group to consider, for that was my only purpose and intent.

Consideration In The Development of Roll Neck Oil Seals

By E. W. FISHER
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. . . . lubrication economy and efficiency is largely tied in with the design of the seal . . . .

▲ FOR more than two hundred years steel has been rolled in a mill. In the last fifty years tremendous strides have been made in techniques, and most recently high speed mills have commanded the limelight. The advances made have brought forth new power lubrication, bearing and sealing problems. There are today bearings with virtually mirror surfaces. Thousands of horsepower turn the rolls supported by these bearings on a precious film of oil. Barrels of oil flow through the arteries to lubricate and to cool these giant machines. At each end of the bearings there rests a thin ring of packing known as an oil seal. It is an apparently minor part, yet actually entrusted to it is the life blood of the mill, oil. The functioning of the seals largely governs the life of the oil and the amount of make up necessary.

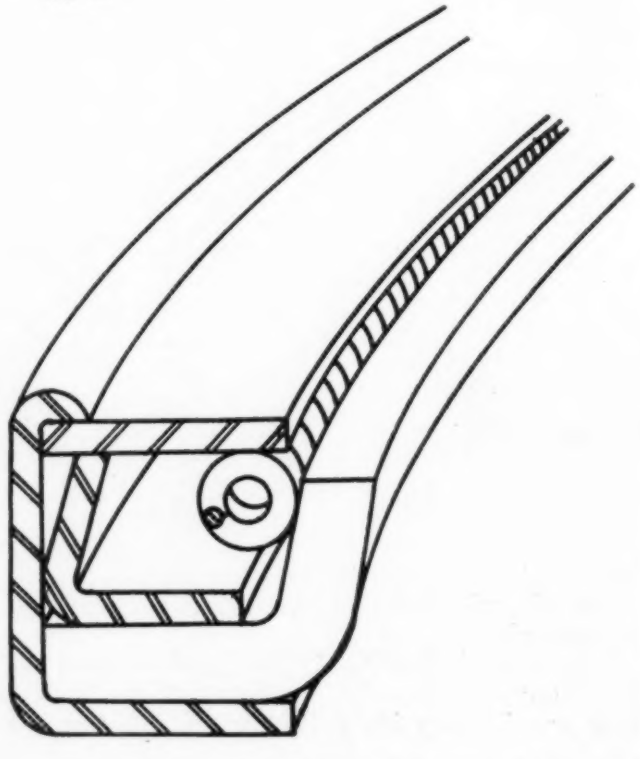
For the past fifteen years, more and more attention has been directed towards the improvement of this oil seal. There have been many varieties and combinations tried. One of the oldest is the leather hat or flange packing enclosed in a metal case with a coiled or garter spring wrapped about the sleeve or lip section around the shaft (Figure 1). Such seals were often used in pairs and might have been assembled in one case, (Figure 2). In dirty jobs where there was much scale or water present, it was usual to face one lip out towards the foreign material and the other in towards the bearing and oil. The outer seal was then accorded some protection by an outer boot and bronze or bakelite ring in the basic form of a rotary or face type seal.

Another type of seal has also been used in place of the flange packings, namely, piston rings, In bearings using piston rings the face type seal was often replaced with a somewhat intricate labyrinth as a baffle against excessive foreign material.

As speeds went up and service conditions became more severe, the problem of sealing became critical. Too much oil was lost, too much water found its way into the oil and the seals required frequent replacement. Therefore the job of improving these seals was undertaken. The theory behind the performance of an oil seal is intriguing and to the users of seals there are some interesting and useful considerations.

First, consider how an oil seal works. It is a device with a flexible member held in close contact under spring load against a rotating shaft. Inasmuch as the spring creates a load, the unit as a whole becomes a bearing. This bearing is really a rather unique product. Unlike a normal bearing it does not have a fixed inside diameter. It has no running clearance. It has no provision for generating its own oil film. In fact this bearing must be designed to

Figure 1 — The lip garter seal is one of the oldest types.



minimize the thickness of any film; otherwise this film will carry too much oil out past the seal resulting in excessive leakage. Considerable work has been done with oil films and when one considers them in relation to oil seals, it is usual to imagine them as quite thick, especially if the oil seems to be "pouring" through. Quite frankly the actual figure is not known. Attempts to apply Poiseuille's law of fluid flow to a seal which seems to be leaking badly would indicate clearances so small that we might say that they must be on the order of a molecule or two thick. Yet this cannot be or our seal would be quickly destroyed; thus one must follow an uncharted course of research. The oil film must be of reasonable thickness to insure satisfactory operation of the seal as a bearing. Yet the film must not be too thick or leakage would be severe. A narrow line of bearing means less gross drag and less heat, but it also means a thinner film and more careful control. Broad contact may be all right for slow speed jobs, but even here a heavier film is likely to develop which in the presence of fine foreign material may mean the entrance of dirt and attendant wear.

Speaking of friction often raises the question of the co-efficient of friction of various materials. When applied to an oil seal this means little for a dry seal would not even come up to speed. There must be at least a reasonable resemblance to fluid film lubrication or the end is at hand. The amount of friction is clearly a summation of several factors; first and foremost—the lubricant, then its temperature. Important are also shaft finish and seal finish. Seal finish is taken care of itself in the case of synthetics quite rapidly, provided only that the shaft is not so rough as to cause excessive seal wear. The seal under normal circumstances, therefore, is quickly polished to a good bearing. Given time enough, the shaft too is polished. With this latter combination optimum conditions are realized. Having established good bearing conditions, this bearing must not let the shaft move radially from its own bearing contact. Not that the seal should in any wise attempt to restrain the shaft, but rather that the seal should freely float with the shaft. This requires a flexible seal, flexibility but not softness for soft materials are not particularly good bearing materials.

While we are considering the aspects of a seal, as a bearing, we should also realize that the seals should be handled as one. Great care is exercised not to scratch the mirror-like finish of the sleeve bearing. Care is taken to keep roller bearings clean. The seals should receive no less attention. No doubt the greatest problem lies in handling and installing the seals. In the store room they should not be laid on the floor, sooner or later to be stepped on and most assuredly to become full of dirt, nor should they be hung on a peg on the wall. When they are driven into the recess in the chock a good clean square edged piece of wood of fair size should be used. The actual driving should be a slow and easy job thus avoiding serious distortions or damaged lips or springs. The shaft should be smooth. The smoother the shaft, the better the seal type bearing will perform. Initial lubrication is not to be overlooked.

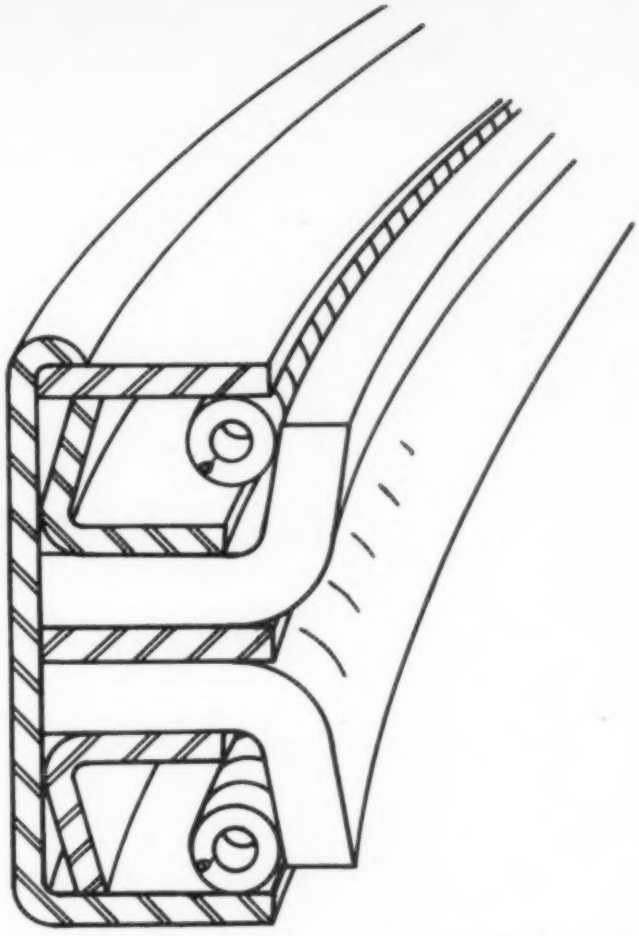


Figure 2 — Lip garter seals were often used in pairs.

Burrs or dents are still further by-passes. And as for helical lead or thread from machining, here indeed can be an excellent pump.

As a bearing the seal requires lubrication. With a single seal this is adequately handled by the lubricant from the bearing itself. The more critical job is where two seals are used. It has been customary to introduce lubricants between the two seals. This plan, if set up and carefully followed, is a most important step toward obtaining reasonable seal life. Originally grease was injected between the seals at periodic intervals. On the older slow speed mills this is fairly satisfactory. There is an important consideration, however, namely: lubricant so fed to the seals will also find its way into the bearing lubricant, thus the lubricant injected should be the same as that used in bearings. If a sleeve type bearing with oil lubrication is used, then feed oil to the seals. Should roller bearings be used with grease lubrication, then feed grease. This avoids contamination of valuable high grade bearing lubricants and yet insures the lubrication of the seals. It has been indicated that the so-called slow speed mill set ups are improved by seal lubrication. This is so. And if one considers some of the newer high speed mills, one would quickly learn that seal life would be very short if auxiliary lubrication were not supplied. Today there are some oil lubricated high speed mills which have a separate oil pump metering a trace

of oil to the seals continuously. This is indeed taking full recognition of the fact that oil seals are bearings and must be lubricated.

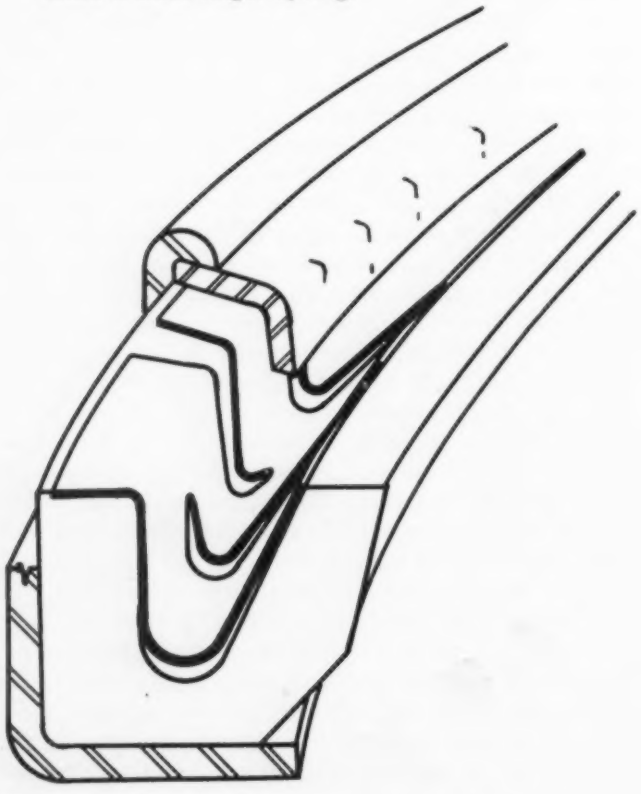
In bearing design there is a wide choice of materials available, so that with all factors fully known quite logical selection is possible with very good assurance of satisfactory results. Most bearings combine two hard materials. Usually one of these hard materials is supported in a deformable matrix such as babbitt except, of course, in the case of anti-friction bearings, or in the case of some marine strut bearings where a soft rubber sleeve does the job. The latter case does involve a unique lubrication job with water in large volume to absolutely guarantee that there shall be no dry contact; this requires unusual design. By comparison the oil seal quickly falls into the class of a plain bearing, lubricated through capillary action by any fluid such as may be present.

Reviewing the "bearing-oil seal" it is noted:

1. The shaft should be in bearing wise condition.
2. The seal should be carefully stored in a clean place.
3. The seal and shaft should be carefully handled in installation.
4. The seal must be flexible.
5. The seal should be lubricated at all times.
6. The seal should be of the best possible bearing material.

Consider the above points from the seal manufacturer's point of view. For the most part he can only talk shaft condition, seal storage, installation and lubrication, but flexibility and materials are his problem and they seem to be capable of infinite expansion.

Figure 3 — The first composition seals usually featured a steel finger spring.



The early leather seals were very hard as received at the mill. In service they soon became very soft and flexible, so flexible in fact that very often the coil spring jumped out. The loss of shape made them very difficult to reinstall after a bearing check, or in some cases after a roll change, depending on the mill bearing design. This loss of shape was due to the extraction of the filler waxes in the leather. An improvement in this condition was made by modifying the spring through special inserts or stops so as to prevent them from collapsing the sealing lip. Also the leather member was improved by going to retan leather which was more heat resistant.

At about this time, the first composition seals made their appearance. See Figure 3. These seals were molded from a crude rubber base in an oil resistant compound to a fairly firm sealing member. They also featured a radically new spring, a tempered steel finger spring composed of series of lugs each operating independently of the other and locked into the seal so that they could not fall out when the seal was removed for servicing.

The service received from both of these early seals was perhaps questionable. On the old mills no doubt it was satisfactory, for even today there are still some installations running on such seals with but minor modifications. However, speeds were being raised and with this came more critical questions; loss of lubricant and spoilage of sheet; dilution and contamination of the oil.

To combat leakage, spring loads were increased. The result was scored shafts and hardened or burned up seals with still worse leakage and now short seal life. A little hind-sight now shows that the "bearing-seals" were being overloaded. The oil film was squeezed too thin. In the case of the leather seal, the thin hot oil found its way through the porous and irregular bearing area which high spring loads could not successfully close. The composition seal was sufficiently stiff so that high spring loads were needed to make it follow the shaft, but in the heat of operation it soon became hard. It at once appeared necessary to have a more heat resistant material.

The first improvement came with synthetic rubber of the chlorinated type, commonly known as neoprene. Direct substitution was worse than the original for the new material was softer, and cross section for cross section more flexible; again the result was over-heating, burning and more leakage. Should it be said at this point that steel mills just should not run so fast?

Next was the buna N type synthetic. Here was an improvement over the chlorinated type. It had no affinity for steel so did not require such treatment as a cloth facing which only wicked the oil past the lip. Nor did it decompose at high temperatures to yield corrosive by-products. Unfortunately it did become hard and almost as fast as the chlorinated type. Good bearings do not wear out very fast. Oil seals functioning reasonably well do not wear out very fast. This is a good and true statement of facts then and today. Then, why all this heavy seal section? See Figure 4.

Analysis pointed out these facts:

1. A very lightly loaded seal would operate cooler.
2. The smallest possible area in contact would make for cooler operation.
3. Light loading meant increased flexibility would be needed.
4. Small area of contact would require perfection in sealing member and shaft.

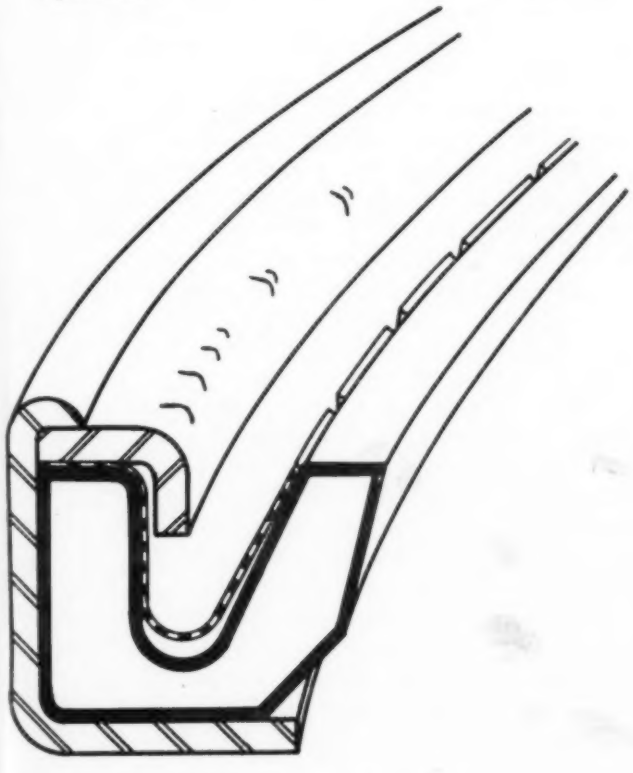
Seal designs were immediately modified, and the results were at once appparent; better sealing and greatly improved life. Synthetic rubber seals through the ability to mold them have led the way.

By following our bearing theory, it has been found that flexibility gained through softness is dangerous as an oil seal must operate on such a thin film of lubricant that failure of the film for an instant may result in seizure. A harder stock is more nearly free of this. Flexibility must, therefore, be gained by cross sectional design, Figure 5. Through the moldability of synthetics, it is possible to design the lip section to suit this theory, and in addition to gains in flexibility it is possible to control and restrict bearing contact. This latter step is almost impossible with leather.

Wear has not been mentioned, that is, beyond scored shafts. A seal operating as a bearing will scarcely more than polish a shaft. Wear of the shaft is invariably the result of foreign material getting under the sealing lip. The nature of this wear is a lapping action, wherein the seal acts as a carrier for the abrasive. There have been some isolated cases of element wear not attributable to shaft roughness.

The cause of this wear has not been determined definitely but it appears to be due to the quantity and type of foreign material. Coarse material seems to be worse than fine dust or powder. All wear is actually, therefore, the result of seal failure, that is sufficiently close contact, a thin enough oil film was not maintained and dirt entered.

Figure 4 — Smaller and lighter seals give cooler operation.



The best solution lies not only in a thin film, but a thin film at the tip of the lip. Any curling away from the shaft, any fuzziness on the dirt side of the seal offers the necessary opening for wear to set in. In this respect, the finger spring either alone or supplemented by a coil spring is the most satisfactory to keep the tip of the sealing lip under load and in as close contact to the shaft as is possible. This spring arrangement is also most satisfactory in controlling the area of contact and the load distribution.

It is possible to attain very nearly any load desired with either the finger spring or the coiled spring. In practice there are other distinctions to be noted over and above the important feature of load location mentioned above. The finger spring is always active irrespective of dirt conditions whereas a coiled spring is rendered inoperative should dirt lodge between its turns. The finger spring is uniformly active around the seal and although its load will vary with its displacement according to shaft movement, it will not be snubbed. Snubbing of a garter spring is the result of the hoop tension the spring is exerting on the sealing lip to hold it against the shaft. This loading causes the individual turns of spring to partially embed themselves in the relatively soft sealing lip and cause this snubbing or hanging-up action. In theory, if one pulls on the sealing lip at one side of the seal, the other side should try to move over with it. Snubbing is a serious handicap tending to eliminate this desired action. As a step towards elimination of snubbing, one seal design uses a finger type spring with curved tips to hold and locate the coiled spring. Finger springs do have one disadvantage, namely, the individual lugs may be deformed by rough handling prior to installation. This is not true with the coiled spring. On the other hand, in the process of installtion, occasionally a garter spring will jump out of the seal, a situation that cannot occur with the finger spring.

It is proper that mention should also be made of radial or face type seals often referred to as rotary seals. In this type the sealing surface is a flat face in a plane normal to the shaft axis. The bearing areas with this unit may both be quite rigid as flexibility is gained through a bellows or sliding contact packing.

Loading is accomplished by a plurality of short helical springs. Sealing faces of the type used in this seal permit choice of the best bearing materials thus theoretically a most satisfactory unit should be possible. There are several problems, however.

First, the sealing faces must be lapped to a perfect finish. Secondly these faces must be perfectly flat. In such large sizes as roll necks require, this becomes a critical problem. Thirdly in the space available it is difficult to provide for sufficient end play. Foreign material reaching most designs to date would be quite likely to jam them and prevent proper movement, and last they are not only relatively expensive

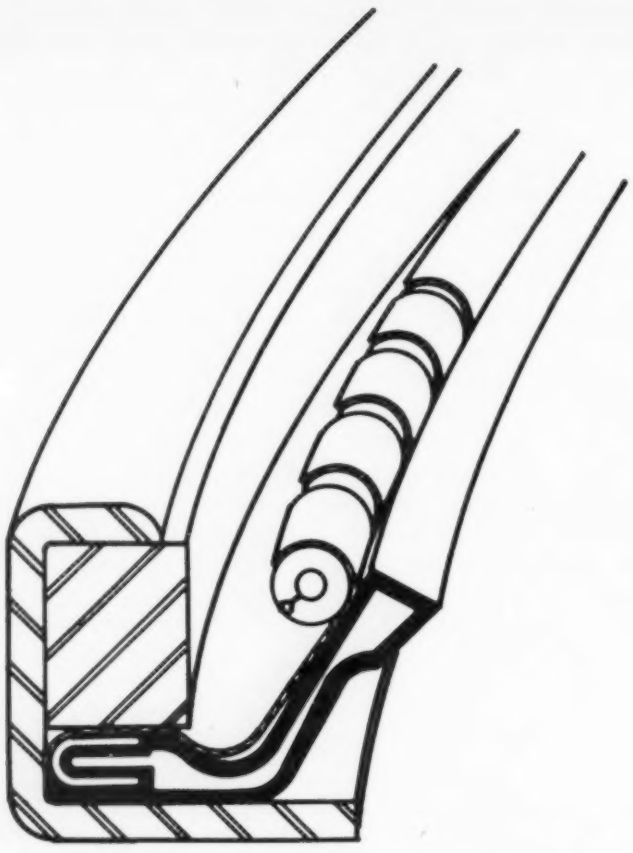


Figure 5 — The flexibility in the seal should come from the cross-sectional design.

but also very easily damaged which could easily run into high maintenance costs.

Piston ring type seals have a very real place on roll necks where pressure is present as they make good bearings to carry the oil pressure load. As positive seals, some difficulties are experienced with rather heavy leakage. Most of this trouble is no doubt due to difficulty in perfectly fitting the rings and in some cases to irregularities in the shaft which the rigid piston ring cannot adapt itself to.

From the considerations presented, there is developed the thought that flexible seals making spring loaded contact normal to a cylindrical shaft present the most satisfactory answer for roll neck seals. They require a minimum of space. They are easily handled and installed; neither services of a crane or a crew of men are required. They are inexpensive and in case of accidental damage may even be considered expendable. The proper seal properly installed will give long service without repairs or replacements. There have been many improvements incorporated in such seals and yet it has not been necessary to rebuild or modify the bearing chocks, for the basic dimensions of these seals, although compact, still leave room for new improvements to be incorporated.

With each improvement it sometimes seems as though that one must be the final answer. No, not that the seals are perfect, but it would seem that everything possible had been done.

To think now that no further improvements can be foreseen is riduculous, present bearing-seals generate heat that limits their life, but silicone rubber laughs at heat and already much research and development has been done in applying this material to seals. It would seem that undoubtedly these are the seals for the new mile-a-minute mills. For the older mills, much may be in store in one of the new synthetic impregnated leathers. However, for tomorrow and the day after tomorrow; seal manufacturers are looking ahead but right now the future trend is not clear.

DISCUSSION

PRESENTED BY

WAYNE G. RITTER, F. R. Magill Co., Pittsburgh, Pa.

C. E. PRITCHARD, Chief Lubrication Engineer, Republic Steel Corp., Cleveland, Ohio.

E. W. FISHER, The Garlock Packing Co., Palmyra, N. Y.

R. A. KRAUS, General Mechanical Foreman, Republic Steel Corp., Chicago, Ill.

Wayne G. Ritter: We agree that flexibility should be primarily gained through cross-sectional design. Another seal design, not covered in the paper, achieves greater flexibility by utilizing more of the usually restricted width allowed for the seal in the machine design. This is accomplished by reducing the amount of metal casing in the seal by vulcanizing the sealing member directly to the metal case. In this design the sealing member is a synthetic rubber compounded to withstand this particular service.

The design is illustrated in Figure 6. It will be noted that, by eliminating part of the metal casing, almost the full width of the seal can be used for the sealing member.

The use of some metal in the seal is advisable, since this provides rigidity and allows the seal to be light press fitted into a bore, thus eliminating the need for a clamping device. The molded seal also eliminates the possibility of distortion of the sealing member in the fabrication of the seal.

A piece of rubber can be noticeably changed in shape by the application of a relatively moderate force, and the stress set up in the material by the force, will return the piece to its original shape when the force is removed if the stress is not too high. If the stress exceeds a certain critical stress, depending upon the compound, the time under stress, the temperature, and other conditions, the piece will return only partially to the original shape when the force is r e m o v e d. As when the similar phenomenon occurs in metal, it is said that the piece has taken a permanent set or that there has been plastic flow in the material. The stress at which this occurs is not as definite in rubber as it is in metals, and is difficult to determine. However, this plastic flow can occur in the clamping of the

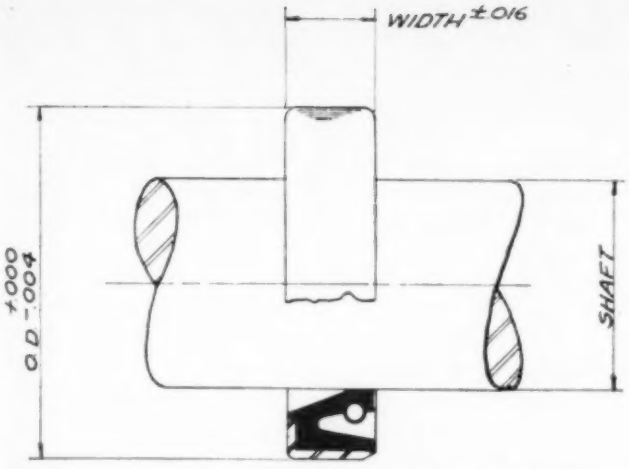


Figure 6 — In this seal, practically the full width of the seal is effectively used.

rubber sealing element into a metal case which can possibly result in irregular contact surfaces in the sealing lip.

Development work is in progress in an attempt to improve the spring loaded shaft type seals now in common use. Other suggested methods of sealing are also being investigated.

▲

C. E. Pritchard: The subject is one in which we are all interested, and we certainly have a number of problems in general mill operations relating to seal practice.

Several comments were made in Mr. Fisher's paper relating to the finish of the shaft. I would be interested in learning just what order of finish you are referring to when you say "... bearing finish or good finish."

E. W. Fisher: I would recommend an rms finish of 20 to 30, if possible.

C. E Pritchard: Where is the line of demarcation between good and bad?

E. W. Fisher: If we get that line up around 40, we consider it rather bad.

C. E. Pritchard: Is 40 and above considered detrimental to the life of the seal?

E. W. Fisher: More than likely, yes.

C. E. Pritchard: A second question is the request, on our part, if possible, for consideration to be given to the design of a sealing member that will withstand a little more abusive handling. I do not mean to condone the rough practice prevalent in the steel industry, but, at the same time, we all recognize the fact that the problem is present. I believe, if a little more thought were given to that one phase in the design of the sealing member, we may come up with a compromise which will be much better than that offered today.

E. W. Fisher: We agree with you very much, on those thoughts. We might say that some of the early seals of the type shown in Figure 4 were pretty heavy sections. They would take a good deal of abuse.

C. E. Pritchard: If my memory is correct it was noted that the resistance offered by this design would tend to stall the roll, on certain types of operations, if you had good surface contact.

E. W. Fisher: That is perfectly true. We had to put very heavy springs in them to make a section like that react. On the other hand, if we make the seal from a softer compound so as to use lighter springs, we lose the bearing qualities. In other words, we can make a fairly heavy section, such as this shown on Figure 4, which would withstand more rough handling, even though the stock is softer. The softer a stock is, the more tough it actually is. It is not going to cut out as readily as firmer stock. However, when we try to run a soft stock on the shaft, if we happen to run on marginal lubrication where there will be a bit of dry contact; then we get that same black streak around the roll that we get when we step on the brakes of our car. The stock just rubs off. We want something that will slide across the dry spots without seizure.

Admittedly, the ideal situation would be a very hard material; something that would make a good bearing. When we try to do that on a shaft-type seal, we must still maintain flexibility so the best we can do is turn around and build in the flexibilty which is shown on Figure 5. We have this section hinged so that this lip is very free to move. After all, we know our shaft cannot be absolutely perfect; even with one-thousandths of an inch gap, you can have a great deal of oil leakage. We do everything we can to maintain shaft contact, and thus must keep a flexibility that will permit it.

In order to avoid overheating, we have to back-off on the spring loading. This starts something of a vicious circle. With the light spring, we must have a very flexible seal. With a very flexible lip it is easy to turn the seal inside out if we attempt to install the seal lip first. Thus for rough handling we should have heavy sections—but this takes us back to the beginning.

I mentioned silicone. Silicone is really phenomenal in heat resistance, there is no question about it. On the other hand, if we think the present materials are weak, take a look at silicone, you can cut it with your fingernail. If you just bend it back sharply on itself, it will tear in half. It has flexibility but it is not tough. Further, if you get dry contact with it, it will wear away before you can do anything about it. It has heat resistance and, if we approach that ideal lubrication point of a true bearing, it will run for years. I can assure you of that.

C. E. Pritchard: Where grease is used as the bearing lubricant, if it turns out to be of a very heavy consistency, is this same lubricant satisfactory for the seal, or would a lighter lubricant be preferred?

E. W. Fisher: It would be preferable to use a lighter lubricant on anything of high-speed nature. It would be preferred because most of the heat is actually being generated in shearing that oil film, but again, we must consider the question of contamination of our bearing lubricants.

Certainly, we do not want to pump a lot of light oil into a roller bearing; it may be grease-lubricated. We then would not have proper lubrication for that bearing. It would be better to replace a fifty-dollar seal than a bearing for several thousand dollars.

C. E. Pritchard: We have found, with some of the

older-type bearings, installations that it is more advantageous to turn the lip out on both the single- and multiple-seal installations; the grease is used in this case as an adjunct sealing member.

E. W. Fisher: That is an excellent plan. Face both lips toward the foreign material; if you can tolerate the loss of lubricant, which may occur. The amount of lubricant lost will depend largely on the type of lubricant, pressure conditions or otherwise.

C. E. Pritchard: Has there been any study made, to date, in the evaluation of the effect of oil versus grease on seal deterioration, both in regard to the present aspects of the development of the silicone type seal, and the modified leather type seal that you mentioned?

E. W. Fisher: All sealing materials come, first, under laboratory consideration for resistance to oils and greases. I would say that practically all of the synthetic rubber seals of the buna-N type are quite resistant within satisfactory limitations to all of the normal bearing lubricants such as grease and oil. We have no particular choice in that regard. The only thing that we do caution against is their use against aromatic materials but even there, most lubricants are not usually sufficiently aromatic in nature to cause any trouble.

Silicone is a miraculous product. However, it is not good at all against silicone lubricants. It will disintegrate. Likewise, it is not good against hot water. I should like to mention, in case any of your maintenance men have heard of silicone and thought of using it against high-temperature steam or water, that silicones cannot be used against such media. With cold water, which you might encounter in a mill, you would have no bad effects.

Neoprene is something you have to watch out for in some of the steps of aluminum rolling. Palm oil enters this picture. This material causes excessive swelling in neoprene similar to the way an aromatic swells buna-N. The buna-N is not disturbed by palm oil. Impregnated leathers will also withstand palm oil. Such leathers are almost as new as silicones, and hold very high promise again of exceptional performance. They have miraculous heat resistance for leather, and, actually, also for the impregnant. Either material alone should be limited to 150 F. With the combination of the two materials, however, it seems to be possible to go up to 300 F. It looks as though we can do something with leather for really high-speed work.

R. A. Kraus: It is difficult to overemphasize importance of the condition of the surface against which the seal lip is operating. If long seal life is expected, practically independent of the seal type, it is of utmost concern to be certain that his critical interface have as low a rms reading as is practical to obtain, and that this finish, once obtained, be not destroyed through careless handling, storage, etc. A slight film of rust or a few scratches or bumps on this surface can very materially decrease the life expectancy of the seal.

E. W. Fisher: Surface finish under the sealing lip is very important and justly should be emphasized. I do feel, however, that it is a more important consideration in regard to sealing efficiency than to seal life. This statement does except very bad bumps, deep scratches or cuts, or heavy rust any of which conditions would abrade or grind out the sealing lip. Minor damage to the shaft usually merely provides channels for leakage. A very light rust which does not noticeably pit the shaft is usually quickly polished off by the seal without materially affecting the life of the seal. The finer the shaft finish, the better the sealing efficiency. Coarse finishes may be bad enough to cut the sealing lip away rapidly the same as with a deep cut or scratch, and are clearly to be avoided. Otherwise the life of the seal, as far as wear is concerned, is governed more by the presence of outside foreign material such as heavy mill scale. To this end any baffles which will reduce the amount or prevent such materials from reaching the seal are highly desirable.

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WEIRTON STARTS NEW ELECTROLYTIC TINNING LINE

. . . . one of the leaders in the development of better and more economical tinplate has been the Weirton Steel Company . . . . the unit here described is another step in tinplate progress . . . .

▲ THE Weirton Steel Company's new No. 4 electrolytic tin-plating line, is said to be the largest and fastest line of its type in the industry. The production capacity of the new line, which coats steel strip at speeds from 2000 to 2500 fpm, gives the Weirton, West Virginia, plant an annual capacity of about 800,000 tons, or 18,000,000 base boxes.

The new electrolytic line gives Weirton a total of four such lines, three producing tin plate and one engaged in coating steel strip with zinc.

Coincident with the inaugural run of the No. 4 line, the Weirton mill has been rearranged for exclusive production of electrolytic tin plate. All hot dip facilities have been transferred to the Steubenville, Ohio, plant. However, three hot dip stacks will continue in operation at the Weirton plant to re-tin "menders" from the electrolytic lines.

The No. 4 line is similar in construction and operation with Weirton's other three lines with these notable exceptions:

1. The new line operates at speeds up to 2500 fpm, an increase of more than 1000 fpm over the old lines.
2. Placement of the "reflow" unit and the chemical treatment tank just after the plating unit and ahead of the looping pit, reversing the positions on the old lines.
3. The new line uses a pickling tank 100 ft long, 30 ft longer than the tanks on the old lines. The extra footage is required due to the high speed of the plating lines.

The new plating line is equipped with two uncoilers at the entry end. While the coil in one uncoiler is being processed, another coil is placed in the second uncoiler, and made ready to be rapidly welded to the end of the predecessor. An 80-ft deep pit, immediately after the welder, permits maintaining a loop which acts as a reservoir, containing enough length of band to allow for welding time at slow line speed.

There are also two reels at the exit end which permit automatic cutting of the band and starting of a new coil on the second reel without stopping the line.

The two entry-end uncoilers are followed by a trip shear and welder. The trip shear is used to square up coil ends before welding. A pair of rubber-covered pinch rolls, located just past the welder, feeds

Figure 1 — Steel moves through the cleaning and pickling tanks from left to right in the photograph. The strip is shown leaving the looping pit at the extreme left and entering the cleaning tanks in the foreground. The scrubber rolls are shown at the right center section of the picture and after them is a second set of tanks which contain the pickling units. Cleaning tanks are 50 ft long, the scrubber is 20 ft long and the pickling tanks are 100 ft long.

the band into the looping pit. Upon emerging from this pit, strip enters a drag unit, then breaks over a deflector roll, and enters an electrolytic cleaning tank 50 ft long. It contains four sets of grids in two electrical groupings, each of which consists of one positive and one negative set of grids connected to a 3000 amp, 16 v generator.

As strip emerges from the cleaning tank it enters a pair of rubber-covered wringer rolls where the excess dragout of electrolyte is squeezed off and returned to the tank. The band next goes into a scrubbing and washing unit where 12-in. diam brushes, rotating at about 3000 rpm, scrub both sides of the band simultaneously, with the aid of high pressure water sprays. The strip then enters a pickling tank which is lined on the inside with a layer of rubber and two rows of acid resistant brick. This tank is 100 ft long, 3 ft deep and 4 ft wide. At each end of it, there is a 24-in. diameter rubber-covered dunking roll under which the band passes and is thereby kept submerged in the acid. The pickling solution is maintained at about 8 per cent concentration by weight of sulphuric acid, and the temperature is held around 180 F by means of steam jets.

When the band leaves the pickling tank, it passes through a set of wringer rolls, and enters another scrubbing and washing unit. Further wringing with rubber-covered rolls removes excess wash water, after which the strip passes into the first deck of the plater.

The plater is 100 ft long, and consists of three levels or decks. In each of the first two decks there are 12 plating cells, all in a line, thus making a total of 24 in the entire plater. A 13th cell on the lower line coats the top side of the strip with a protective coating. When it is in use, only 11 cells are used on the second level so that an equal layer of tin will be applied to both sides of the steel.

Each cell is 6 ft long, 5 ft wide and 12 in. deep, and is connected to a 7500 amp, 18 v generator. Between the cells, and at the entry end and exit end of each of the two plating decks, there is a pair of rolls between which the band passes. The bottom roll is rubber-covered, and, by spring pressure at its ends, bears up against the top roll thus effecting tight contact between them. The top roll, called the cathode roll, is made of steel, and has a copper commutator with carbon brushes at each end. It takes the current off the strip, and is connected to the negative side of the generator. There are, therefore, 13 of these pairs of rolls in each of the two plating decks, and they are all motor driven in synchronism with the main drives.

The main anode support, located in the center, is a solid tin casting, and is connected to the positive side of the generator. It extends across the full cell width. Anodes are solid tin, each 30 in. long and 3 in. by 3 in. in cross section. One end of the anode rests on the main anode support, while the other rests on an auxiliary, nonconducting support located in the end of the cell. Thus, all anodes are placed in the cells with their long dimension in the direction of band travel. There are two beds of anodes in each cell, each of which is composed of about 15 anodes lying in close proximity to each other across the cell width. Each bed is kept level, and the top of it is about 1½ inches below the band passing over it.

The electrolyte, which is principally stannous chloride, is continuously pumped into each cell from a 15,000 gal storage tank located under the plater. The solution level is maintained up against the bottom of the band by sealing the exit end of the cell, and permitting overflow only at the entry end, at which point a clearance of only about ⅛-in. between cell and band is allowed. Overflow from each cell returns by gravity to the storage tank by way of return lines. Current up to 7500 amp maximum per

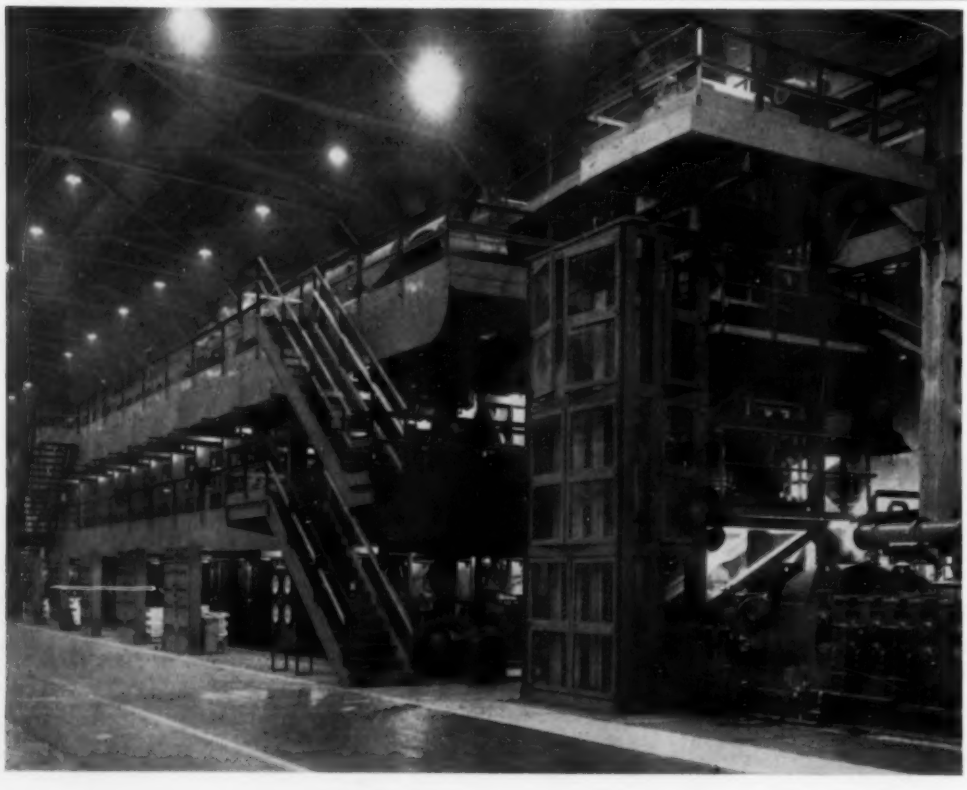

Figure 2 — The new No. 4 electrolytic tinplate line plates strip moving at a rate of 2500 fpm. Plating is done in a triple deck structure. On the lower deck the under surface of the plate is coated as it moves from left to right. The strip reverses direction on the middle deck where the other side is coated, and on the upper deck the electrolyte is washed from the surface. The reflow unit is located in the tower in the right foreground.

cell thus passes from the anode support into the anodes, which form the positive pole of the cell, then through the electrolyte to the band, which is the negative pole. Tin is plated on the bottom side of the band in each deck.

Since, for obvious reasons, a plating line must be operated at various speeds, plater generators are so governed electrically that, for a given coating weight to be plated, current furnished by them to the cells changes automatically with the line speed, so that a uniform coating of tin is applied at all speeds. In addition, a master control compensates for variations of internal resistance in individual cells. If the current from one cell falls off, the other generators pick up the load until the excessive resistance in that cell is cut out by the plater operator.

In passing through the bottom deck, the band becomes plated with tin on its bottom side. Upon issuing from the bottom deck, it is deflected 90 degrees to a vertical direction of travel, and, about 8 ft above this point, it is again deflected 90 degrees to a horizontal direction of travel into the second deck of the plater, so that it now moves in the opposite direction from that in the first deck. Thus, in going from the first level of the plater into the second, the strip is turned over, so that what was the top side in the bottom deck becomes the bottom side in the second deck where it is now electroplated.

At the exit end of the second level, the band, now fully coated on both sides, is again deflected 90 degrees in each of two steps so that upon entering the third level the band is travelling in the original direction. While passing through the third deck, the excess dragout of the electrolyte is recovered from the band, and is run back to the storage tank under the plater. The remaining electrolyte is then thoroughly washed and wrung off the band through a series of three sets of wringer rolls and water sprays.

At the exit end of the top level, the band is given a hot water dip, and is then dried thoroughly as it travels past a series of hot air blasts.

The band then moves to a roll at the top of a steel tower 28 ft above the floor. A high-frequency inductive field is created inside this tower by a series of rectangular coils made of ½-in. water-cooled copper tubing. The tin coating on the band is melted or reflowed by the heat generated in the strip as it comes down through the coils in this tower. The frequency is 200,000 cycles at 17,000 volts, and the power input is electronically controlled so that the tin is heated to only slightly above its melting point, thereby avoiding any burning or oxidizing. The band then enters a tank of water at the bottom of the tower, 17 ft below the floor, where the strip is quenched, thereby setting the tin coating.

The band now enters a chemical treatment tank where it is subjected to an electrolytic action which improves the adhesion of organic coatings applied to the tin plate by the can manufacturer. In this process, strip is made the cathode in an alkaline chromate solution at current densities of from 10 to 40 amp per sq ft. The strip then passes through a series of sprays and wringer rolls, where it is washed completely free

Figure 3 — This view of the new electrolytic line shows the control panel which controls the entire tin plate line.

of all alkaline salts and thoroughly dried. The strip then enters the tension unit which is of the same mechanical design as the drag unit, which pulls against it. The tension unit is motor driven and pulls the band through the plater, pickler and cleaner. The strip now enters another pit that supplies the slack ahead of another drag unit. It is then subjected to an electrostatic oiling.

Air is blown through a body of cottonseed oil to produce an oil-air fog that is introduced into a vertical chamber, down through which the strip passes between two grids spaced about 6 in. apart. Each grid consists of a steel frame 40 by 60 in., made of ½-in. diameter steel rod, with fine wires, about 2 in. apart, stretched horizontally across it. These two grids are connected to a 50,000 v power pack. Application of this high voltage produces a corona effect at the wires. As the oil fog passes between the highly charged wires in the grids, the fine particles of oil assume a static charge of electricity and are attracted to both sides of the passing band which is of opposite polarity. The amount of oil deposited on the band is controlled by the density of fog introduced into the chamber, which in turn depends on the air flow used to create the oil fog. The coating of cottonseed oil thus applied is extremely light —around 0.25 grams per base box. Its function is to help the sheets slide over each other more readily during fabrication. It also has some beneficial effect in lithography.

After the oiling operation, strip passes on to the reel, where it is again wound onto a coil, which is then sent to a cutting line to be sheared to the customers' specified dimensions.

Generators in the sub-station under the new electrolytic line will produce 180,000 amp at 18 v to operate the plating process. In contrast to this low voltage is the high frequency concentration of power for the reflow tower which uses 1800 kw. Other generators produce electrical energy from zero to 230 v to operate the adjustable voltage system which controls the drive motors on the line itself.

WIRE ROPE-USAGE, CARE, MAINTENANCE

By A. J. KING,
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. . . . maximum economy in the use of wire rope, one of the steel industry's essential tools, is obtained only when the rope is properly selected and adequately maintained. . . .

Rope, in one form or another, has been used as an aid to civilization throughout many centuries. While most engineers have some knowledge of and experience with wire rope, a brief account of the development and usage of this important link by means of which useful energy (primarily tensile) is converted into desired uses so essential to modern industry, is interesting, if not entirely necessary. Coincident with the ever increasing usage of wire rope as a hoisting medium is the realization of the dangers of misapplication, necessitating intimate knowledge covering intelligent selection, proper installation, effective maintenance and adequate inspection, of this indispensable tool of industry.

A tension device (today called "rope") is almost as ancient as the human race itself. In the so-called "stone age", strips of hide and pliant reeds were joined together in devious and ingenious ways, for supports and hoisting. After this crude approach a number of fibres were twisted together so that they held together by mutual friction when a force was applied, making possible longer and stronger mediums. Throughout many centuries no particular advancement in rope was made, until early in the 19th century, when the need of a more rugged and stronger material to withstand the conditions which made it impossible to continue use of fibrous material, caused engineers of the day to seek suitable and available substitutes such as some form of metal, either ferrous or nonferrous.

The only available material, that which combined both flexibility and strength, was wire—and this was utilized. The crude forerunner of the wire rope of today, was made by laying several large wires parallel to each other, and binding them together by wrapping the entire unit with fine wire. This early method of construction had its first practical application and usage as a suspension member of a bridge. Strange as it may seem, suspension cables used today are basically of the same construction, differing only in the number and size of parallel and covering wire, grade and strength of steel and methods of fabricating the unit.

To eliminate the need for wrapping parallel wire to fine wire, the idea of twisting a small number of large wires together was conceived, and because many small wires woven together are stronger than one wire of equal diameter, many small wires were woven into units called strands, a number of which were subsequently twisted together. Although the twisting of these strands into a rope provided greater strength, flexibility, which is a necessity when used on sheaves and drums, was practically an impossibility. Therefore, to overcome this condition and make wire rope adaptable to wider ranges and greater usage, strands of multiple wires of numerous designs were developed and twisted around hemp or wire cores. This provided strength, flexibility, fatigue resistance and ruggedness (ability to withstand abrasion, distortion, and abuse) to sustain loads under conditions of occasional or repeated bending and abrasion and is what distinguishes wire rope from other tensile devices.

Basically, on this foundation rests the principle on which wire rope is constructed today, and which is technically defined as "an article or device formed wholly or in part of a plurality of wires helically twisted together to form a strand or unit", and then "several strands helically laid around a core of fibrous or metallic material". However, it is not as simple as it seems or looks. In this modern day of scientific development in all branches of industry, demand for efficiency, increased production and efficient handling of material, with a minimum of cost and low maintenance, has resulted in demands upon wire rope manufacturers to keep abreast of this progress. It confronts them with the problem of producing many types, each particular one designed for specific service, having desired physical properties. It also necessitates continued and exhaustive research in refinements in steel manufacture, wire drawing and rope fabrication, to insure the consumer the ultimate in wire rope efficiency.

WIRE ROPE—A "MACHINE"

Inasmuch as "wire rope" is composed mainly of such a commonplace article as "wire", there is an erroneous impression that wire rope is an ordinary, relatively unimportant, obscure piece of operating equipment, when compared to the general run of large, heavy and complicated machinery found in industry. Wire rope is often little appreciated by the average user, and therefore, the full measure of efficient and economical service built into it, and maximum economy of operation, is frequently never fully realized. Wire rope is a complex machine, composed of many moving parts, which are designed and manufactured with precision and exactness to bear a very definite relation to one another. In fact it has many more moving parts than many pieces of equipment classified as "machines".

Wire rope as a product is a highly specialized precision tool adaptable to many uses. It is designed and produced in many constructions and several grades or strengths to meet varied operating conditions and exacting service requirements. However,

like any machine, even the finest of wire rope can be destroyed quickly through faulty installation and usage, or improper care or maintenance. Therefore, although rugged in character, it is logical to expect that the ultimate service rendered will depend entirely upon its treatment during installation and throughout its subsequent period of use.

USAGE

Wire rope is used for many industrial purposes such as hauling, hoisting, conveying, supporting and strengthening. The greatest single user of wire rope is the steel industry. From raw materials on through the finishing mills and fabricating plants, steel-making employs a succession of equipment that is absolutely dependent upon wire rope in its operation. In underground coal and ore mines, and in open pit mines, there is found the most spectacular excavating machines ever conceived by man. Wherever cars and ore boats are unloaded by modern methods and equipment, on ore bridges, blast furnaces, open hearths and bessemer furnaces, wire rope will be found as one of the important components for operating clamshells, hot ladle cranes, conveyors, loaders, car dumpers, haulages, to mention only a few. From this point on, the handling of ingots, billets, slabs, the various products of finishing mills and fabricating plants, is done by a variety of wire rope reeved conveyors, cranes, hoists, which constitute an essential part of modern production machinery.

The second largest user is the oil industry, and both oil and natural gas wells are drilled by wire rope, which is an indispensable tool in "bringing in" a well. The lumber industry is a heavy user of wire rope. In present day logging, regardless of the method of operating, wire rope is an indispensable working part. The quarrying industry likewise depends heavily on wire rope and not infrequently remote mines and quarries must resort to incline railways and tramways to haul their output to an accessible shipping point. In the transportation industry, the flow of goods depends upon wire rope in a wide variety of ways. On ships and motor transports, there is found all sorts and kinds of rope, mostly steel, to expedite the handling of freight and to load and unload heavy materials economically.

In the construction field, projects are being built in a length of time which a few years ago would have been incomprehensible, through the use of equipment which relies on wire rope for its operation. Bulldozers, angle-dozers, scraper-wagons, shovels and draglines for clearing sites; excavating trenchers that dig ditches for sewers, gas mains, water mains, and electrical conduits; pile drivers; cranes that handle structural steel and concrete; all need wire rope for their operation.

Wire rope also plays an important part in our everyday life. The constant supply of electricity, gas, water, the maintenance of our streets and roads, elevator transportation in our buildings, all of which services are considered essential, require wire rope for the operation of related machinery. In fact, the use of wire rope has become so wide-spread that hardly an industry can be mentioned that does not require wire rope for a variety of applications.

WIRE ROPE DESIGN—APPLICATION

In the above summation of general uses it can readily be seen that wire rope is a tensile device. It differs from other tensile members in that it has the ability to sustain loads under conditions of repeated bending, and because of this it must possess strength, flexibility and fatigue resistance. Because it is a moving part of some unit it must also possess abrasion resistance. Depending upon service conditions, these properties are required in varying degrees. Individually these properties are not difficult to obtain, but collectively they represent a complex problem because they are so related to each other that it is often impossible to accept one without some detriment to the others. Satisfactory performance on any installation or under a specific set of conditions demands that the wire rope possess all properties, but not always in the same proportions and therefore, to meet the requirements of modern industry in the diversified use of wire rope, it is necessary to produce many types and various grades of wire rope each having certain and definite characteristics and properties.

The complexity of wire rope usage can perhaps be better realized when it is understood that hundreds of combinations of size, grade and construction, can be furnished. Because of the great variety manufactured it should not be difficult to select a wire rope of proper size and construction, made from suitable material best adapted to service requirements, provided knowledge of qualities of ropes and conditions of usage is available. No particular benefit would be gained by enumerating all of these since many are produced for special applications. Suffice to say that, for general requirements and for simplicity and clearness in discussion, wire ropes can be divided into three major grades or strengths and three major types or construction classifications.

GRADES

The first wire ropes were made of iron wire and "iron grade" is still used for certain purposes. Subsequent industrial developments necessitated wire rope of greater tensile strengths. As a result, manufacturers produce three standard grades of steel wire for fabrication into wire rope, each differing in strength and physical characteristics, and usually referred to as: mild plow, plow, and improved plow steel. Improved plow steel is the strongest and most wear resistant. It is approximately 15 per cent stronger than plow steel which in turn is approximately 15 per cent stronger than mild plow steel. The trade names simply indicate a tensile strength per square inch minimum and maximum range, with corresponding appropriate physical properties such as: ductility, hardness, elongation, etc. There are variations to this also, but for general purposes, from these standard grades, it is possible to select an appropriate one for practically any condition or service. Manufacturers' catalogues and engineering hand books list the ultimate strengths of each size in each grade.

TYPES AND CONSTRUCTION

As indicated before, there are literally hundreds upon hundreds of different types of rope manufactured, almost as many as there are applications, and ropes specially designed for specific uses, but generally speaking, all ropes fall into three general types or classifications as follows:

Group No. 1—Course or hard laid.
Group No. 2—Medium or soft laid.
Group No. 3—Special or extra flexible laid.

By referring to manufacturers' catalogues, it will also be noted that there are two general types of wire strand construction, one having all of the outside wires of one size, and the other having outside wires of unequal size, that is, small and large. In any of these geometric designs, the idea is to distribute the metallic area to the best advantage, keeping in mind two factors: areas exposed to bending fatigue and wear; and strength in reserve. This reserve strength is that percentage of total metallic area which is protected from surface wear by the outside wires, and can generally be safely relied upon for the entire life of the rope, provided of course, that internal corrosion does not occur. This factor is important when choosing a rope construction where careful rope inspection cannot always be maintained.

6 x 7 COARSE OR HARD LAID

This type, commonly known as haulage rope, is highly resistant to abrasion because of its large wires, therefore, is especially suitable for standing lines and such applications in which the rope may be dragged along the ground or over rollers and scrubbing boards. However, because it is made of large wires, it is a stiff construction and cannot withstand the effects of repeated bending over sheaves and drums as well as a rope made up of a greater number of smaller wires. In view of its minimum reserve strength, limited flexibility, and maximum abrasion qualities, it is restricted to and is commonly used for guying derricks, smoke stacks, towers, on land, and for standing riggings on ships, as well as for numerous usages in oil fields.

6 x 19 MEDIUM OR SOFT LAID

This type, generally classified as a hoisting rope, is more widely used than any other. The wires being smaller than in the 6 x 7 construction, the rope is more flexible, and can be more readily passed around sheaves and drums of moderate size. However, because the component wires are finer than the 6 x 7 construction, it will not withstand as much abrasion as the coarser haulage or standing rope. The universal appeal of this constuction can be attributed to the fact that is possesses the best balance between fatigue and abrasion resistance in the most common sizes of rope. It is used on almost every kind of modern apparatus and finds popularity, in view of the average reserve strength, flexibility, and abrasion resistant properties, which are required in a great many uses of wire rope.

6 x 37 SPECIAL OR EXTRA FLEXIBLE

This type of hoisting rope is widely used in overhead traveling cranes, and is most popularly called "crane-rope". It is the most flexible of the six strand constructions. To obtain this flexibility, the wires must be comparatively small and numerous; therefore this rope is not suitable on installations where resistance to abrasion is a primary service requisite. However, because of its high fatigue resistance, it is especially suitable on equipment where sheave and drum sizes are small and bending or flexing is frequent and severe. It has the greatest reserve strength and flexibility of any of the standard constructions, although its one drawback is the minimum abrasion-resistance property. In this flexible category, sometimes a rope of 8 x 19 construction is made and used. This is generally for special purposes; light loading, high working load factors, which allow the use of slightly coarser outside wires. The metallic area of the rope, however, is distributed in eight strands rather than six strands. This rope should not be used generally except upon consultation of the manufacturer.

OTHER TYPES

Into this classification falls a myriad of rope constructions, all off-shoots of the three standard types mentioned above. In this category there are ropes and strands such as 6 x 41 shovel ropes, 18 x 7 non-spinning ropes, 6 x 12, 6 x 24 running and mooring lines, aircraft cable, sash cords, tiller ropes, locked coil track strand and smooth coil track strand, 6 x 25 Type B and 6 x 30 Type G flattened strand and bridge ropes. Some are common to rope usage, others are specifically designed and applied to special applications. Most manufacturers' catalogues and engineering handbooks have a very vivid and detailed description of the design, construction and physical properties and characteristics of these ropes. Space here does not permit going into any detailed description of this special category of wire rope. However, there is one type of rope which should be discussed in any paper relating to the subject. This type is known as "preformed".

PREFORMED WIRE ROPE

The development of wire rope from early history to present day has been already described without referring to a process developed within the span of the last few years which represents a major improvement in fabrication. The process involves the preshaping or forming of each wire and strand to the helical position it normally assumes in the finished rope, which gives it certain improved characteristics. Preforming affects the general rope structure and can be and is applied to most any grade, construction, or type of rope or strand.

Any wire rope, even in the state of perfection pre-

viously outlined, due to cold working of wires, twisting when stranding and laying, develops an inherent twistiness or locked up stress, similar to that existing in a clock spring when wound up, which manifests itself in devious ways. When a non-preformed rope is cut or broken it will untwist or lose its balance, which explains why seizings or bindings are necessary. As a result, such internal strain, when working with or against bending stress, and other outside factors or agencies of service, has a tendency under certain operating conditions to decrease rope life. Elimination of the internal stress and strain is accomplished by this process.

The general advantages of a preformed wire rope are many; but to name just a few, these are as follows: It is easy to handle. It requires no seizings, will not fly apart when cut or broken in service, retaining its balance. It normally resists kinking because of its freedom from liveliness and twistiness. It does not have a tendency to rotate in grooves. It is easy to splice, and normally, winds smoothly and evenly on drums. In short, preformed wire rope, because it is free of internal stresses, has complete freedom of action under tension and bending and, therefore, each component part can adjust itself to various conditions and carry its share of the load.

In comparison to a non-preformed rope, it is equally as strong, equally or slightly more flexible, equal in crushing, wear, and corrosion resistance, but has a much higher resistance to fatigue caused by bending. It can, however, be equally abused by the user, and requires the same care and maintenance to prevent loss of efficiency and resultant poor service. It is not a "fool-proof" rope in the strict sense of the term. Its only disadvantage lies chiefly in the fact that by virtue of the inertness of the individual wires, it requires normally a closer visual inspection to determine the condition of the rope. Broken wires are not as easily detected because, when worn or parted, the rope does not "porcupine", that is, does not protrude as in a non-preformed rope. However, throughout the years of its use, experience has indicated no particular hardship or inability to evaluate the condition of rope from a broken wire standpoint. Additionally, even a disadvantage sometimes turns out to be an advantage because, a pre-formed rope, when worn, is a safer rope to handle, since broken wires will not protrude and injure workman's hands.

A study of the above advantages will make the superiority of a preformed rope more understandable.

WIRE ROPE—CARE AND MAINTENANCE

Machinery of any kind requires proper care and attention to assure satisfactory operation. Wire rope, considered a complex and intricate machine, is composed of numerous parts in the form of wires, strands and cores. These parts when subjected to loads or stresses engage in limited, yet positive, movement. Thus, the proper use, care and maintenance of wire rope is just as important to service, performance and economy, as it is to any precision made machinery. Yet it is not uncommon to see a reel or coil of wire rope delivered to a user, carelessly dumped or unloaded almost any place, where it is bumped by a truck or run over by a tractor. Then when the rope is put into use, it is promptly forgotten, neglected and abused. It is no wonder then that rope replacements and maintenance costs are so high. Abuse of many kinds must be guarded against, and neglectful maintenance eliminated if fully satisfactory performance is to be secured. The correct handling of wire rope both before and during its use, is very essential if best performance and ecenomy are to be obtained.

When wire rope is received from a manufacturer, care should be taken to prevent damage in handling. No wire rope is intentionally mishandled, but reels of wire rope should not be (but actually are) dropped from cars or trucks, as the weight of the rope will collapse the drum on which it is wound. This causes rope to cut in and it is very difficult to unreel the rope without severely damaging it. When using a bar to roll a reel of wire rope, the user should pry against the reel head, not the rope. When removing wire rope from the reel on which it was received, or from a coil, it is imperative that the reel or coil rotate as the rope unwinds. Attempts to unwind wire rope from stationary coils or reels will result in kinking a rope, and once a kink is formed, the rope at that point is ruined beyond repair. When a shipment of wire rope is not to be immediately put into service, it should be stored in a dry place away from acid or corrosive fumes and protected from the weather. The manufacturer takes extreme precaution when shipping in cars, so why not the user.

When cutting wire rope from a reel prior to installing, take pains to seize or bind the ends no matter what kind of a rope it is. Seizings or binds, as they are sometimes called, are required to prevent the untwisting of wire ropes and are applied to both sides of the point where it is to be cut. Inadequate seizings, which do not preserve the rope structure, but permit the strands to untwist, result in shortened service because of the unbalanced condition of the rope. Avoid kinks during installation by proper and careful handling. A kink in wire rope, no matter how developed, will greatly reduce the life of the rope. Do not allow the rope to form a small loop. However, if a loop does form, remove it before it is pulled down, otherwise the rope is liable to be permanently damaged. In this condition it is of little value as the strands and wires, being damaged, will break up very quickly at this point, often resulting in an actual sudden breakage. No matter how well a kink may appear to be straightened, the rope is definitely weakened at this point.

After a wire rope is installed, it is advisable always to run the new wire rope with a light load or with no load for a short period of time. This "breaking-in" process gives the component parts of the rope an opportunity to adjust themselves to the conditions under which the rope is to operate. The time spent in "breaking-in" a wire rope will pay dividends in extra useful rope life. During use avoid, if possible, overwinding and crosswinding. It is not good practice to have more than one layer of rope on a drum. If this cannot be avoided, the succeeding layers

should not crosswind, but should wind regularly in the groove which is formed by the preceding layer of wire rope. Actually the crosswinding is caused by negligence and is an extremely bad practice. This type of abuse causes more damage to wire rope than most users realize. The general opinion seems to be that ropes are rugged enough and are built to withstand abuse of this kind, but even the best of wire rope eventually breaks down if repeatedly damaged.

Avoid overloading and shock loads. Usually these are of indeterminate magnitude. Even if rupture does not take place, the elastic limit of the rope has been exceeded with consequent permanent distortion resulting. Sudden stresses caused by jerking a wire rope may exceed the strength of the rope and break it. Jerks which do not break the rope cause rapid deterioration and shorten rope life. When picking up or moving a load these sudden stresses may equal a value several times the weight of load lifted. Loads should always be gradually applied and the rate of acceleration should be kept as uniform as possible, keeping within the designed factor of safety (ratio of strength of rope to working load) to minimize these dangers.

Generally speaking, it is not possible for the wire rope manufacturer to set proper safety factors for the various types of wire-rope-using equipment. This factor can and does vary with individual equipment, depending not only on the loads applied, but on the speed of operation, the acceleration and deceleration, the length of rope, the size of sheaves and drums, the conditions causing abrasion and corrosion and the facilities for inspection as well. There are published guides of suitable minimum safety factors which have been established by experience as required on the average installation. However, the largest possible safety factor is desirable as it represents, in most cases, increased economy and greater safety of operation.

All operating wire ropes are subjected to bending around sheaves or drums during normal operations. Service obtained from wire ropes is, to a large extent, dependent upon the proper choice of size and location of the sheaves and drums. Therefore, wherever possible, wire rope should be operated over sheaves and drums of the largest permissible diameter. The fatigue effects of bending are manifested by the tendency of the wires in the wire rope to break off square, and small sheaves and drums will cause a permanent set in a heavily loaded rope. Experience has established the fact that from a service viewpoint, a very definite relationship exists between the size of the wire rope and the size of the sheave or drum about which it operates.

It is impossible to give a definite minimum size of sheave or drum about which a wire rope will operate with satisfactory results, because of the other factors affecting the useful life. If the loads are light or the speed slow, smaller sheaves and drums can be used without causing early fatigue of the wires, than if the loads are heavy or the speed fast. Reverse bends, where a rope is bent in one direction and then in the opposite direction, cause excessive fatigue and should be avoided whenever possible. When a reverse bend is necessary, larger sheaves are required than would be the case if the rope were bent in one direction only, and should be spaced a sufficient distance apart to allow component parts to adjust to normal position before bending in another direction.

Manufacturers' catalogues and engineering handbooks show the minimum tread diameters of sheaves and drums for use with the various sizes, grades and constructions of wire rope. It should be clearly understood that these are the minimum sizes which, under favorable operating conditions, are permissible and only reasonable rope service can be expected. If the features of operation, such as speeds and loads, are severe, larger sheaves and drums should be used, the amount by which they should exceed these minimum figures depending upon the severity of the conditions of service. There is also a table of recommended tread diameters, but experience has shown that the use of sheaves and drums larger than shown in these tables will result in increased wire rope service, which usually will more than warrant the additional cost.

Of the many forms of wire rope abuse, with its attendant loss of efficiency and economy, the following are a few major ones due to neglected or faulty maintenance: wire ropes are not properly lubricated; are allowed to drag over obstacles; are operated over tight, scored, and fluted sheave and drum grooves, and are operated over sheaves and drums out of alinement. Additionally, there are a number of maintenance suggestions which if practiced will result in greater efficiency and economy from wire rope. These are reversing ends; cutting back; lubricating regularly; and periodic inspection.

Wire ropes are properly lubricated during fabrication and come to the user ready for service, but this initial manufacturing lubrication, no matter how efficient, is not sufficient and will not last the life of the wire rope. Periodical field application of a good grade of oil or grease is absolutely essential. The lubricant should be free from acids and alkalies; should have sufficient adhesive strength to stay on the rope; should be able to penetrate between the wires and strands; should be non-soluble under the conditions prevailing where the rope operates; should have a high film strength; and should resist oxidation.

Operating or used ropes should be cleaned before they are re-lubricated. The cleaning may be accomplished by means of wire brushes or scrapers, or by compressed air or superheated steam. The object is to remove all foreign material and old lubricant from the valleys between the strands and from the spaces between the outer wires. The lubricant may then be applied in any manner suitable to field conditions. It may be brushed onto the rope with a stiff brush; applied by passing the rope through saturated waste, or by passing the rope through a trough or box of lubricant; or the lubricant may drip onto the rope, preferably at a point where the rope opens slightly from bending. The object in any case is to apply a uniform coating to the entire length of rope. If possible, wire rope on idle equipment should be cleaned, lubricated, wound on a reel and stored. If removal is not possible or practical, the rope

should be cleaned and lubricated in its entire length for protection against corrosion.

Wire ropes are frequently allowed to drag over obstacles resulting in unnecessary wear and abuse. The use of supporting sheaves and rollers decreases the wear on the rope and results in increased service. Sheaves and rollers should have grooves sufficiently large to prevent pinching of the rope. All sheaves and rollers should be re-machined or replaced, when scored by the rope, to prevent unnecessary wear on the outer wires of the rope. These sheaves and rollers should be free to rotate, large enough in diameter to avoid unnecessary bending, provide adequate support, and be light enough in weight to readily start and stop as the rope starts and stops. Heavy sheaves and rollers build up momentum when turning, which causes slippage when the rope stops. They are slow to pick up speed when the rope starts. This produces additional slippage which in turn produces abrasion. The installation of supporting rollers at irregular intervals tends to dampen vibration which is of particular benefit on long inclines or where operating at comparatively high speeds.

Proper maintenance will not neglect sheaves—they are of prime importance in prolonging rope life. Sheaves must be of ample diameter to prevent excessive bending stresses—must fit the rope—too narrow grooves will pinch and distort the rope causing wear, internal stress and friction; with too wide grooves the rope will flatten from lack of support. Worn sheaves prevent proper seating and will cause trouble with the best of wire rope. Sheaves should also be alined so that the axis of the rope is parallel to a line drawn from the center of the groove of one sheave to the center of the groove of the next sheave. This is important in order to prevent excessive wear on the rope caused by its bearing against the flanges or dragging across the shoulders. This unnecessary wear will destroy the outer wires long before the rope has given nominal service. The use of sheaves with broken flanges or with scoring or fluting produces the same undesirable results.

Wire ropes operating over sheaves and drums out of alinement are detrimental to service and economy. On installations where it passes over a lead sheave, then onto the drum, it is important that the lead sheave be located at a sufficient distance from the drum to maintain a small fleet angle at all times. This "fleet angle" as it is known and commonly called in the industry, is the side angle at which the rope approaches the sheave from the drum. It is the angle between the center line of the sheave and the wire rope. Experience has proven that the best wire rope service is obtained when the maximum fleet angle is not more than one and one-half degrees. A one and one-half degree angle is the equivalent of approximately forty feet of lead for each foot of rope traverse travel either side of the center line of the sheave. Thus a drum with a 3-ft traverse travel, with the center of the travel in line with the lead sheave, should be located approximately 60 ft from the lead sheave.

Good maintenance dictates practices of economy which involve reversing ends and cutting back at points of attachment. A rope is usually changed end for end to distribute the wear and fatigue resulting from bending and vibration. If these destructive forces are uniform throughout the system, no economy is effected by such a change. On most installations, however, these forces are more severe for one-half of the rope than for the other half, and reversing the ends increases the rope service. The object of cutting short lengths of rope from the drum or fastened end, is to change the position of the rope. Wear and fatigue are usually most severe at certain definite points on wire-rope-using equipment, and the removal of a short length of rope subjects different portions to these destructive forces. Cutting back removes that section next to end fastenings where maximum localized fatigue from vibration often occurs. In order to take full advantage of this method of obtaining increased service, it is often advisable to use a length of rope slightly longer than normally required.

In addition to the initial proper lubrication, it is important that ropes be lubricated periodically and during their entire life. Whether idle or working, a wire rope loses its lubricant. Operating a rope works out the lubricant—the flowing lubricant provides a film which retards excess of abrasion and fatiguing of the metal and induces free action of the wires and strands under bending conditions. It minimizes friction and wear between individual wires; between rope and sheaves and drum. It keeps all wires free to slide on each other as they must do when bending. Because it is such an effective deterrent to corrosion, proper lubrication at regular intervals is perhaps the most important aid to longer rope life and increased operating efficiency, protecting both inside and outside wires against destructive rusting. It is the safest, surest method of preventing excessive wear and corrosion inside the rope where it is most dangerous because it cannot be seen. There is no known means of inspection which will enable the inspector to estimate even approximately the strength of a corroded rope. A rusty rope is a definite liability.

Periodic inspection of a wire rope is necessary in view of the dangers and damage involved, should a wire rope break prematurely or without warning. One of the outstanding features of wire rope as a tensile device is derived from the fact that it consists of multiple members. If a wire rope has not been abused, it gives warning of the approach of eventual failure by the progressive development of broken wires, which can easily be detected a considerable length of time before its ultimate in service is reached. Failure of all units in a wire rope will not usually occur simultaneously. Due to the fact that fatigue and wear develop gradually, wire breaks occur successively and not simultaneously. This characteristic is what makes wire rope the most dependable tensile mechanism that is available for hauling, hoisting, conveying, supporting and strengthening.

It is an efficient machine and tool—make good use of it—take care of it—maintain it in proper working order—and it will give you long, efficient, and economical service.

CONTROLLED HEATING FOR ROLLING

By W. H. DAILEY, JR.
Surface Combustion Corp.
Toledo, Ohio

. . . . substitution of properly maintained, adequate control for the visual judgment of the heater is resulting in more economical and uniform heating of steel for rolling . . . .

▲ There are at present two general procedures for heating metal for rolling or forging:

1. Heating with a very high temperature head at a uniform production rate and rolling immediately after the metal reaches the rolling temperature, with no storage of heated metal; characterized as high speed heating.
2. Heating with a relatively low temperature head with provision for non-uniform production rate, and storage of metal at rolling temperature; characterized as low speed heating.

This is not a hard and fast rule, since some high speed heaters have provision for storage of hot metal, and many relatively slow heating devices, incorporating storage, may also be equipped with additional automatic control devices and otherwise modified to heat at high speeds.

In the past, the slow speed storage type heaters have been used almost exclusively for all types of heating. For heating small billets, or slabs, they are now being rapidly displaced wherever the rolling or forging operation is conducted with long runs on standard size pieces at uniform high production rates.

In steel mills, batch-heaters (soaking pits) are used almost exclusively for heating ingots, and continuous pusher type furnaces incorporatng storage are used for large slabs.

Basic problems encountered in the physical operation of these heating devices, and solved to a greater or less degree by using automatic control devices are:

For low speed heating:

1. Excessive loss of metal due to oxidation. When heating steel this loss varies from ½ to 3 per cent depending on the relative surface area. In addition to the direct loss of metal, increased damage is done by loss of the dense surface skin of rimmed or capped ingots. This outer skin, which is highly desirable for maintaining a good surface during subsequent rolling operations, is partially or completely removed if the steel is severely oxidized during heating.

The loss due to oxidation can be minimized by maintaining the oxygen in the atmosphere around the metal at a low concentration and by accurate control of the temperature of the heating devices.

2. Surface checking and edge cracking due to depletion of alloying elements and penetration of oxides into the grain boundaries.

Reduction of oxidation by maintaining low oxygen concentration, and minimum temperature, and by rapid heating with shortest possible time at high temperature, reduce this type of defect.

3. Maintenance of uniform rolling temperature with varying piece size and heat requirement.

Proper handling of the heating design with provision for maximum interchange of radiant heat and adequate automatic temperature control can completely solve this problem.

For high speed heating:

1. Oxidation and overheating on a sudden reduction in load.

Automatic temperature controls for one or more stages of heating and synchronization of fuel input with production rate can satisfactorily solve this.

2. Damage to the heating equipment due to local high temperature.

Many high speed heaters use ceramic surfaces to promote combustion and as heat reflectors. Failure of automatic control devices could quickly cause damage, consequently, the temperature limiting controls are usually made very simple and rugged.

Summing up the requirements for control devices for low speed heaters, the primary functions are:

1. To secure and maintain uniform distribution of heat energy at minimum temperature head over the entire area in a batch heating furnace such as an in-and-out furnace, or a soaking pit.

To secure and maintain uniform distribution of heat emission across the width of a skid type continuous furnace, together with proper regulation of the heat emission pattern from entry to discharge end.

2. To reduce oxidation, particularly on long holding at rolling temperature.

The oxygen is controlled by accurate maintenance of air-fuel ratio, particularly at low fuel inputs and by careful maintenance of sufficient internal pressure to insure that no air can leak in.

3. To maintain accurately the desired rolling temperature.

For fast heating, the primary requirements are:

1. Accurate control heat emission rate.
2. Shut down without damage in event of a sudden interruption of operation.

Equipment is available for almost anything required in the way of automatic control. The basic problem is to determine, before construction of the heating equipment, exactly what is desired. Is the rolling or forging process pretty much standardized as to size of piece to be heated, and is the heating rate (i.e., number of pieces per hour) to be uniform, or will it vary widely? Will much storage of hot steel ready for rolling be required, or can the heating equipment discharge the steel when it is ready for rolling.

Another important consideration is the operating and maintenance organization. If the plant has a maintenance force set up to handle complex control devices, and if there is an effective incentive rate, it is usually advantageous to use complete automatic control even though its functions may be quite complex. On the other hand, if adequate maintenance is not continuously available and if there is no incentive rate, it may be desirable to use the simplest possible control system with a minimum of control devices and a relatively large number of recording devices, so that the supervisors may have an accurate record of the operation.

A major effect of the use of automatic control, which is overlooked in many instances, is the transfer of considerable responsibility from operating to maintenance personnel. Heating metal for rolling by manual control is an art (and a very inexact one). Visual observation is used to determine surface temperature, and degree of uniformity of temperature through the section being heated. The men who do this work learn it by long experience, and in most cases, use very large safety factors. When they encounter abnormal situations, they try to further increase this safety factor. They frequently pay little or no attention to measuring devices for temperature or heat input, and usually these devices become inaccurate and undependable due to lack of incentive for proper maintenance.

Application of complete automatic control largely eliminates the need for exercise of judgment by the operator of the heating devices. He merely selects the temperature established for the material being heated, and operates the proper push buttons to start and stop the operation. The responsibility for proper operation is in the hands of the maintenance organization. In many recent instances, particularly when heating uniform size billets for forging or for rolling rounds or piercing tubes, the control of the heating device is in the hands of the roller or press operator.

The above instances are limiting cases and most installations lie somewhere between them. However, it is our experience that the most important problem encountered in application of automatic control to heating for rolling is the transfer of responsibility from the operator to the maintenance and staff organizations. In many cases expensive control installations are made without adequate provision for responsible maintenance. When this occurs, the control devices soon become undependable, and the production rate and quality and economy suffer. Correction of such conditions, if allowed to prevail for any length of time, is expensive and requires many weeks of close supervision.

In general, the high speed heating devices designed to deliver uniform sized pieces at a regular rate have very simple control, often merely a device to manually regulate the heat input. As the functions of a high speed heater are increased, the control becomes very complex, particularly where the size and rolling rate are to be varied and where storage of heated metal is desired together with lower power or fuel consumption.

For batch or slow speed heating, the control devices may also be very simple, but if maximum speed of heating is desired together with storage at high temperature, the controls become even more complex than those used for the high speed heaters.

CONTROL EQUIPMENT, HEATING FOR ROLLING TEMPERATURE

The primary control devices are those for temperature. Unfortunately the measurement of temperature is still complicated, and not entirely satisfactory, since we do not yet have any simple method for measuring the temperature of pieces while they are still being heated. Thermocouples on each piece are usually not possible, and radiation measurements by aiming at the surface are inaccurate unless the furnace walls are at the same temperature, which is seldom the case.

Therefore practically, the control is usually achieved by measuring the temperature of the finished billet or slab with a radiation type or color comparison instrument, and regulating the furnace wall temperature for slow speed heaters, or the fuel input for high speed heaters, to maintain the desired temperature in the heated piece. Many continuous type heating furnaces measure and control the wall temperature at several stages of heating. High speed heaters are frequently divided into sections with

radiation temperature measurement as the piece travels across the opening between sections.

It has been found very important to obtain actual wall surface temperatures, unaffected by the radiation from the flame and we take precautions to secure good thermal contact between the wall surface and the thermocouple or radiation target.

Either thermocouples or radiation receivers make satisfactory measuring elements as long as they are accurately checked at regular intervals. We find that frequent sources of error are improper aiming of radiation elements, poor thermal contact between thermocouples and the furnace wall, and leakage of hot furnace atmosphere out or cold air inward along the target tube or thermocouple protection tubes.

AIR-FUEL RATIO

For high speed heating and for continuous slow speed heating, the control of the air-fuel ratio is not much of a problem, since the range of fuel input is relatively limited and the control forces are very high.

In the case of soaking pits for heating steel ingots, the problem is difficult since the heat requirements vary over a range as great as 10 to 1 or more, and very accurate ratio control is desired at the low end of the range in order to minimize oxidation when storing the ingots at rolling temperature with very low fuel demand. To insure satisfactory operation over this wide range it is necessary to design the primary flow measurement elements to deliver maximum usable force to the ratio controller, and generally the fuel flow and the air flow forces are made equal to insure maximum accuracy. It is necessary to carefully adjust the force measuring system for minimum possible friction. We find that frequent checking is necessary to maintain accuracy under these conditions.

High speed heaters cause very little oxidation due to the short time involved. However, they usually have very accurate fuel-air ratio controllers to further reduce the oxidation and to maintain accurate control of the rate of heat delivery to the metal being heated. Precisely adjustable orifices with exactly equal pressure drops and stable discharge coefficients are widely used for this work, and are very successful.

In some high speed heaters, automatic devices are used to change the fuel-air mixture to the proper ratio for production of an inert gas to enable storage of the hot metal at or near rolling temperature without oxidation. This is useful if the rolling or forging equipment is subject to frequent shutdown and it is desired to start up again without heating delay or loss of material.

PRESSURE CONTROL

Automatic pressure control has no direct function in heating for rolling, but is frequently necessary because of limitations of the furnace structure. Its use sometimes adversely affects the operation of other control devices.

Fuel-fired high speed heaters usually generate so much combustion gas internally that they operate at high pressure and no controls are needed.

Batch type and low speed heaters, particularly those of large dimensions, incorporating storage of hot metal are usually subject to leakage and unless a positive pressure is maintained at all points, air will enter and increase the oxygen content and reduce the temperature locally.

Since the hot gases inside the furnace are lighter than the air outside, the pressure at the top is much higher than at the bottom and in high furnaces with openings at the top the pressure regulation is a difficult problem. To eliminate air infiltration a relatively high pressure must be maintained at the top and escape of hot furnace gases can easily damage the furnace structure in this region. Control devices are used to accurately control the internal pressure at the minimum value required to prevent air infiltration.

GENERAL

In several recent installations, the trend has been toward complete automatic control with no provision for manual operation except as required to shut down in an emergency. This has resulted in very simple furnace structures and control devices. The operation of this equipment has shown great advantages in control of quality, reduction in maintenance and operating costs and sustained high production rate.

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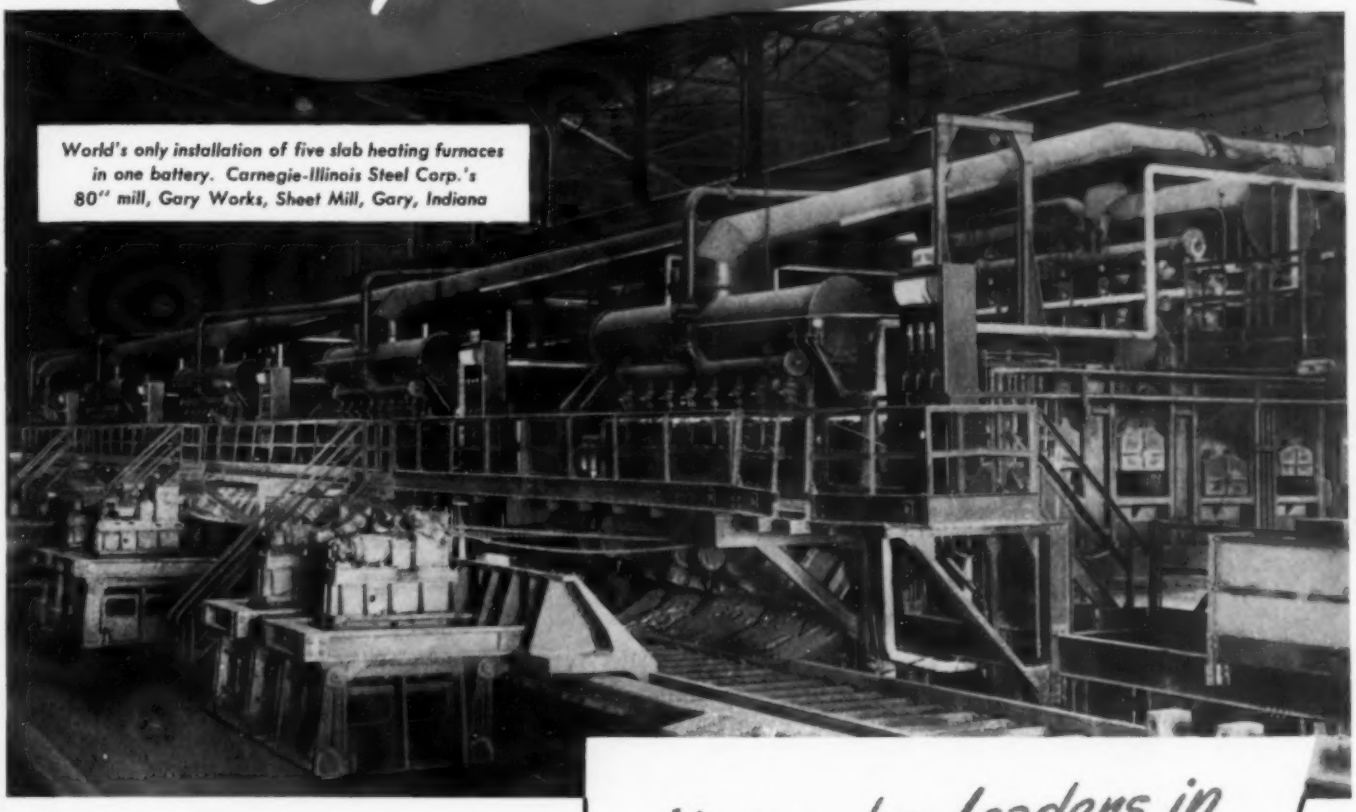

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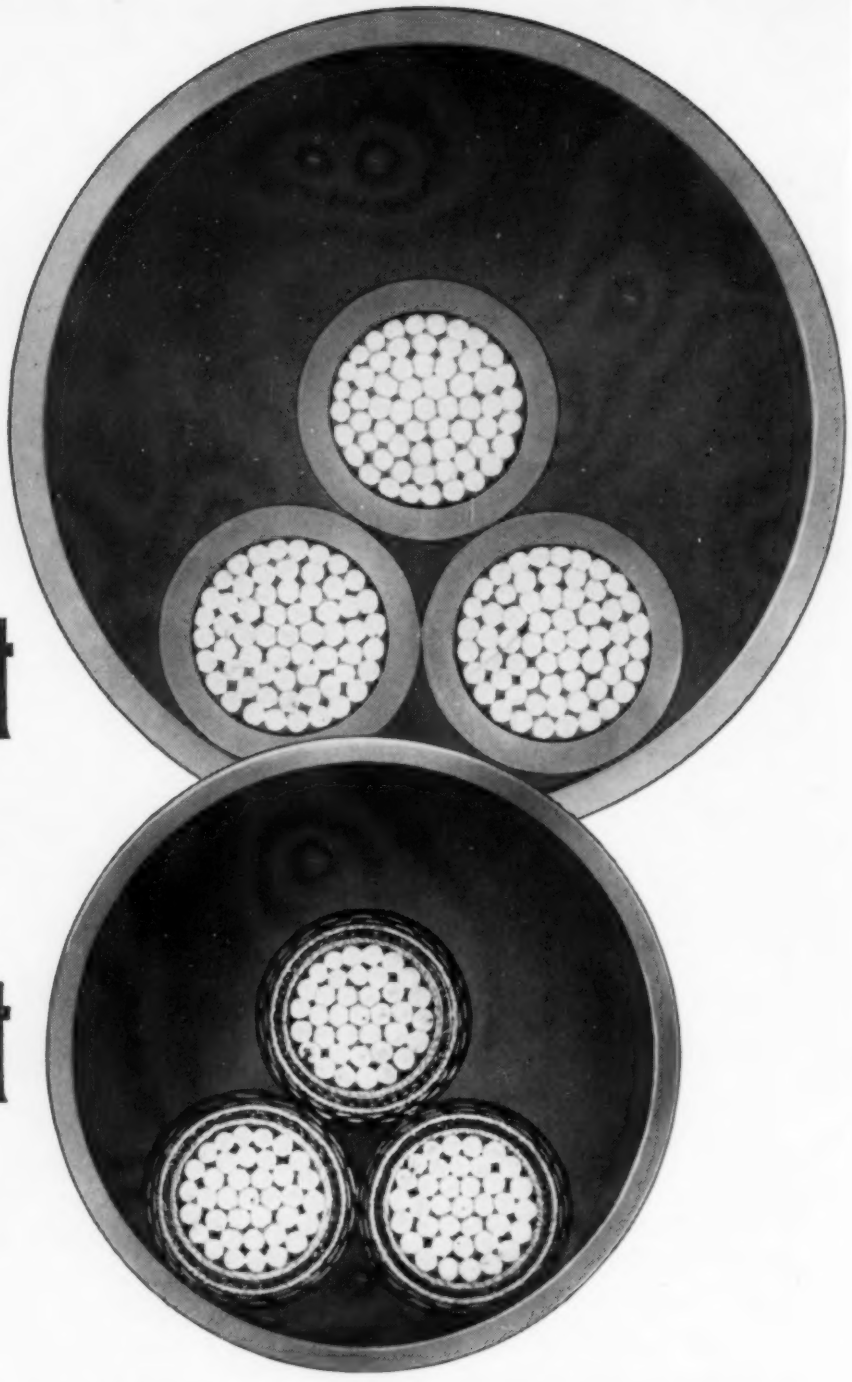

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End view of Standard Resistor Unit, with nuts and insulating washers removed, showing elongated holes in the end frame and illustrating the method used to support P-G Resistance Grids in the end frames.

"Floating Bolt" construction, as used in P-G Resistor assembly, provides space to allow the resistance grids to expand under heat. This feature automatically prevents *warp* or *buckle* since the grids are free to move within their maximum limits of expansion . . . Provision for expansion, resistance to corrosion, adequate ventilation, plus steel and mica as basic materials, assure you of longer trouble-free resistor service . . . Try P-G.

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

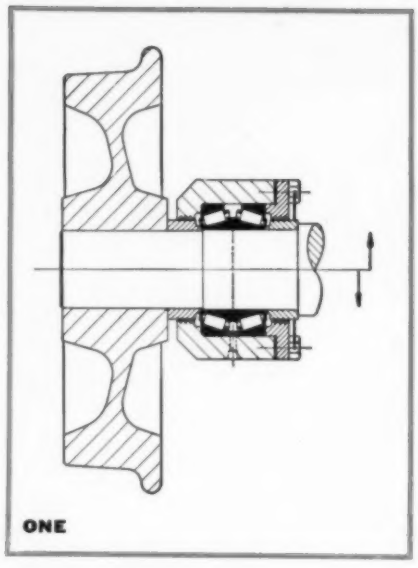
Four ways to cut ingot car maintenance costs . . . with TIMKEN® bearings

WHICHEVER of these typical Timken® bearing ingot car applications you choose, you can be sure of extra operating advantages and a minimum of maintenance. Timken bearings keep cars rolling smoothly, reduce starting resistance 88% of that of friction bearings. Thrust washers or thrust bearings are unnecessary. Axle wear is eliminated. Lubricants are retained longer.

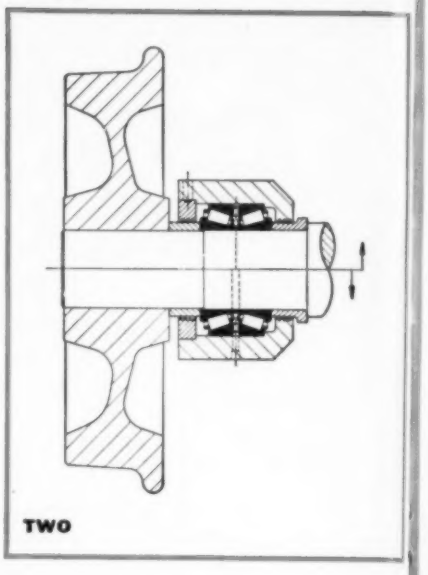
Thanks to the precision manufacture and smooth surface finish of Timken bearings, friction is minimized. The tapered design of Timken bearings permits them to take any combination of radial and thrust loads, entirely eliminating the need for thrust washers or auxiliary thrust bearings. And because Timken bearings are case-hardened and made from Timken fine alloy steel they take even the toughest shock loads. Lubrication time and material costs are reduced due to the tighter closures permitted by the close tolerances of Timken bearings.

The many advantages of Timken bearings have been proved time and time again in all types of railroad applications. No other bearing has so much to offer . . . no other bearing is so fully proved. Our Engineering Staff will be glad to help you solve your bearing problem. Write The Timken Roller Bearing Company, Canton 6, Ohio. Cable address, "TIMROSCO".

This symbol on a product means its bearings are the best



ONE



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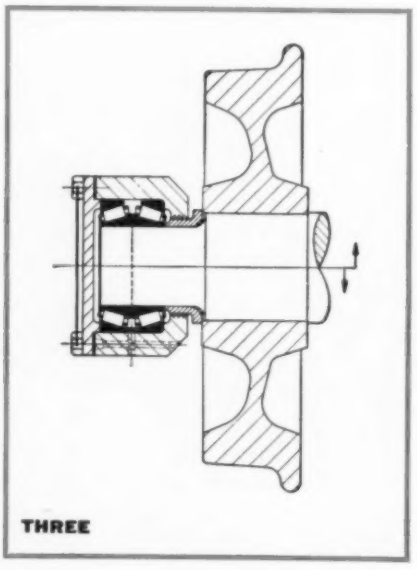

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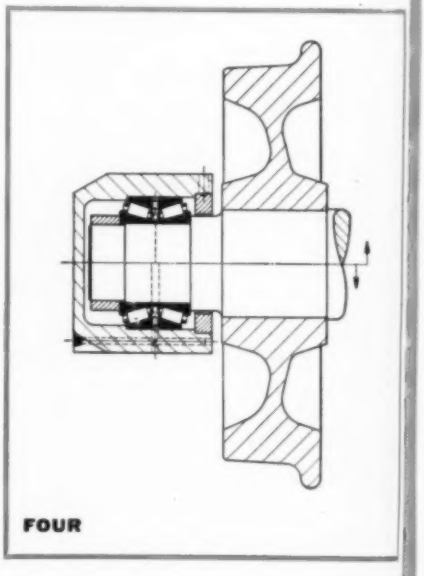


FOUR

FINISHED TO CLOSER TOLERANCES

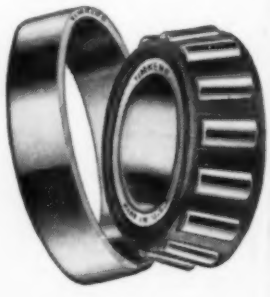
Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at Timken.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

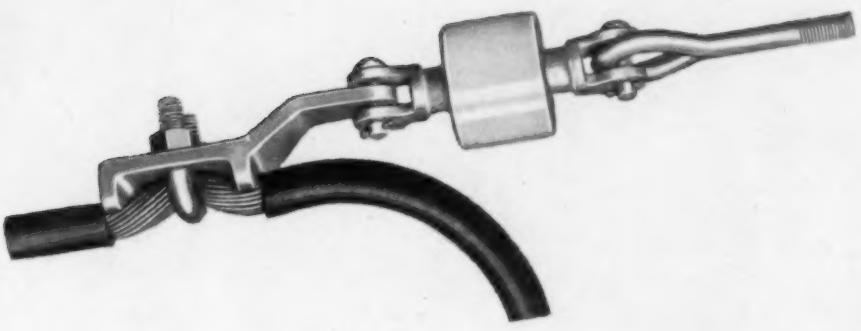
TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ↕ AND THRUST →◎← LOADS OR ANY COMBINATION →✳←

"DEAD-END" YOUR FEEDER CABLE SIMPLY . . . SAFELY . . . SECURELY!



Positive insulation— superior strength . . .

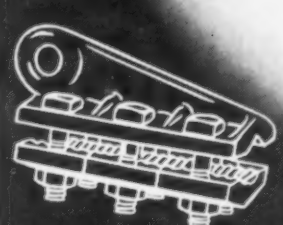
For over thirty years, industry has been choosing Keystone clamps and insulators to dead-end heavy feeder cables.

Cables just don't pull free from Keystone clamps—abundant bearing surface and sturdy construction insure a permanent installation. Sound design makes these clamps easy to attach, easy to tighten, easy to tape.

You'll find that Keystone Giant Strain Insulators will prevent current leakage, short circuiting and flash-over, even under adverse operating conditions. They're available in mica or porcelain, in all sizes and with a variety of fittings.

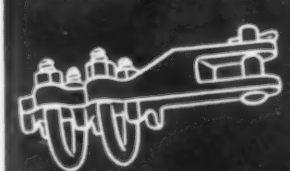
If you want positive clamping, high tensile strength and dependable insulation, you want Keystone cable clamps and insulators. For more detailed information, send for our new booklet on Industrial Feeder and Traveling Electrical Contact Material.

Typical application of Type "P" clamp, using No. 61349 Porcelain Covered Strain Insulator.



TYPE S-6 KEYSTONE Cable Strain Clamp. Similar to S-4, above, but with 6 bolts and separate clamping portions for heavy duty.

TYPE S-4 KEYSTONE Cable Strain Clamp. Internally corrugated to assure firm grip on cable. Bronze lower half furnished for AC service.



TYPE PD KEYSTONE Cable Strain Clamp. Two forged U-bolts provide increased cable grip where high strain is encountered. Bronze U-bolts for AC service.

TYPE HW KEYSTONE Cable Strain Clamp with Insulator. Insulation is cut away from cable at clamping point. Keeps strain in direct line with center of cable.

ELECTRIC SERVICE MANUFACTURING CO.

1721 CAMBRIA STREET • PHILADELPHIA 32, PENNA.

MAKERS OF CONTACT RAIL AND WIRE SUPPORTS, AND COLLECTION DEVICES

Trabon LUBRICATES 264 BEARINGS AUTOMATICALLY ON WATAUGA DAM

Installation of two Trabon Barrel Pumps on Watauga Dam in Tennessee, an important link in the TVA power and flood control program, solved a lubricating problem which rivaled the dam in size.

The pumps are installed in a powerhouse approximately one mile from the dam site and serve to lubricate turbines which control the intake and linkage mechanism. No manpower is needed to operate the system, equipped with a warning device, which flashes a warning of any interruption in the proper flow of grease to each bearing.

WRITE FOR BULLETIN 469

Trabon systems have ONE indicator at the pump, assuring positive lubrication. Trabon systems operate efficiently when buried under dust, dirt, water, or grime.

Regardless of the size or type of your machine, Trabon — with 20 years of experience — can save you time and money.

Call or write today.

Trabon

OIL AND GREASE SYSTEMS

TRABON ENGINEERING CORPORATION
1814 EAST 40th STREET • CLEVELAND 3, OHIO

Date-line Diary...

April 1

▲ The M. E. Solomon Co. of Pittsburgh acquired the steel sheet mill as well as some other facilities at Apollo, Pa. from the M. M. Landay Co. The mill will continue to operate under the management of the Whitney-Apollo Steel Corp.

April 2

▲ The Weirton Steel Co. reports that its new coal mine in northern West Virginia which went into production in December 1949 is now producing one-third its capacity or 1500 tons a day.

April 3

▲ The Alan Wood Steel Co. reported net income in 1949 of $2,255,840, compared with $4,116,444 in 1948.

▲ Based on reports from companies having 94 per cent of the capacity of the industry, the operating rate of the steel industry is scheduled at 96.8 per cent of capacity for the week beginning April 3, 1950. This is equivalent to 1,845,300 tons compared with 1,843,400 tons one week ago.

▲ Armco will supervise construction and operation of a strip mill at the Cornigliano Steel plant near Genoa. This mill is estimated at $87,000,000. Armco will also work on the modernization of a sheet mill at Terni and install a continuous strip process at Turin for Fiat. Owner of the Cornigliano and Terni plants is Finsider. Part of the financing will be done by ECA.

April 4

▲ The Department of Commerce reports that new construction put in place in the first quarter of 1950 totaled $4,400,000,000 for a new record.

▲ The Follansbee Steel Corp. announced that it has now retired its bank indebtedness, and is now free from debt except for ordinary current payables.

▲ American Iron and Steel Institute reported that employment rose in February to 613,400. Average hourly earnings were $1.704 in February against $1.720 in January. Average work week was 38.8 hrs in February.

▲ Secretary of Commerce Sawyer reported that employment rose in March to 57,551,000, up 598,000 from February. Unemployment decreased 561,000 to 4,123,000.

▲ Price of zinc advanced ¼c to 10½c a lb. in east St. Louis. Tin dropped ½c a lb to 74¼c in New York.

April 5

▲ The Jones & Laughlin Steel Corp. announced that it had completed negotiations with six life insurance corporations to purchase $40,000,000 of first mortgage bonds to be used in completing the post-war plant improvement program.

April 6

▲ The American Iron and Steel Institute reported that cold rolled sheets shipped in 1949 totaled 6,887,000 net tons. Shipments of steel pipe were 6,935,220 net tons. Both products set new records.

▲ The National Tube Company started production on its new pipe mill in McKeesport, Pa. The mill is rated at 100,000 tons annually and will produce pipe up to 36 in. in diameter.

▲ American Railway Car Institute announced that domestic freight car deliveries in March totaled 1,712. Orders during the month totaled 6,201 and the backlog on April 1 was 30,539 compared with 26,055 the previous month.

▲ Consolidated Western Steel Corp. started production on 30-in. diameter pipe at its new mill at Orange, Texas. The mill will eventually have an annual capacity of 100,000 tons.

April 7

▲ The F. W. Dodge Corp. reports that construction contracts awarded in the 37 states east of the Rockies were $1,300,201,000 in March for a new all-time high.

April 8

▲ The Koppers Co. has been awarded a contract to build a new battery of 59 coke ovens at the Aliquippa Works of the Jones & Laughlin Steel Corp. at an estimated cost of $4,000,000. The 59 new ovens will carbonize 1433 tons of coal per day and will be of the underjet type. The company also will build an extension to the boiler plant.

April 9

▲ FDIC reported that assets of banks insured by them hit a new high of $170,000,000,000 at the end of 1949.

April 10

▲ Based on reports from companies having 94 per cent of the steel capacity of the industry, the operating rate of the steel industry is scheduled at 97.8 per cent of capacity for the week beginning April 10th, 1950. This is equivalent to 1,864,300 tons of ingots and castings compared with 1,845,300 tons one week ago.

April 11

▲ The Reading Railroad announced that it plans to buy 1500 new freight cars at a cost of $6,500,000.

▲ American Iron and Steel Institute announced that in 1949, 8,300,000 net tons of foreign ore were imported for a new record high level. Largest supplies came from Sweden, Chile and Canada.

▲ The Federal Reserve Board reported that a buying survey indicates that consumers expect to buy 1,000,000 new homes in 1950.

April 12

▲ The Lehigh Valley Railroad ordered 1500 new steel box cars of which 1,000 will be built by the Bethlehem Steel Co., and 500 by Pullman Standard Car Manufacturing Co.

▲ Eugene Grace, chairman of the Board of the Bethlehem Steel Corp., reported that his company's business is running over theoretical capacity and orders indicate this will continue for some time.

April 13

▲ Columbia Steel Co. reported that it set a new record for monthly steel shipments with 62,947 net tons of products shipped during March.

April 14

▲ The British Iron and Steel Federation reported that British steel output for March was at an annual rate of 17,000,000 long tons.

▲ President Truman vetoed the Kerr Natural Gas Bill, thus leaving the way open for FPC to regulate sales of natural gas in interstate commerce.

▲ A Connecticut Finance Advisory Committee authorized an engineering survey for a steel mill in New England at a cost of $60,000 for the survey.

April 16

▲ The 36-in., 4-stand, tandem cold reduction strip mill of the Weirton Steel Co., Weirton, West Vir-

ginia will have its speed increased from 1500 to 3000 fpm. Additional electrical equipment will be installed which will increase total hp to 10,100.

April 17

▲ Steel operations scheduled for the coming week are 100 per cent capacity which is equivalent to 1,906,300 tons of ingots which will be a new high record.

▲ In a report to the Celler Committee, Secretary of the Interior Chapman urged that wider and real competition be fostered in the steel industry through encouragement of investment in new companies.

April 18

▲ The Allegheny Ludlum Steel Corp. reported the highest sales volume in its entire history for the first quarter of 1950 with a figure of $37,551,378 and net earnings of $2,270,681.

▲ Price of copper rose 1c a lb to 19½c.

▲ The Carnegie-Illinois Steel Corp. announced an expansion program in the Chicago district which will increase tinplate capacity at Gary by 120,000 tons. A fourth electrolytic tinning line will be installed operating at 1000 fpm, as well as a continuous annealing furnace. The works at South Chicago will increase capacity of the 44-in. slabbing mill which will finish additional slabs for the Gary works.

April 19

▲ The Acid Open Hearth Research Association announced that the total tonnage of acid open hearth steel melted in 1949 was 866,614 tons of which 46 per cent was for ingots and 54 per cent for castings.

▲ Charles M. White, president of Republic Steel Corp., told the Celler Judiciary Committee that bigness was the thing that made this country great.

▲ Price of zinc was raised ½c a lb to 11c a lb at East St. Louis.

▲ George H. Love, president of Pittsburgh Consolidated Coal Co., stated that soft coal producers will lose 40,000,000 to 50,000,000 tons of coal sales in Eastern markets because of huge fuel oil importations.

April 20

▲ The price of lead moved up ¼c a lb to 10¾c a lb in New York.

▲ Price of steel scrap advanced $1.00 a ton in the Pittsburgh District with No. 1 heavy melting selling at $33 a ton.

April 21

▲ The Interstate Commerce Commission authorized Eastern Railroads to reduce freight rates on certain iron and steel products effective May 1.

▲ Consumption of Lake Superior iron ore in March 1950 was 5,947,807 gross tons. Iron ore stocks on hand at blast furnaces and Lake Erie Ports totaled 20,864,766 tons on April 1.

▲ Koppers Co. announced that coke was first produced at the new steel plant near Concepcion Chile. The blast furnace will be blown in during the first week of May and the whole plant will be in operation sometime in June. Cost of plant has been in excess of $70,000,000.

April 22

▲ The American Iron and Steel Institute reports that planned expenditures for new plants and equipment in the iron and steel industry will be about $468,000,000 in 1950.

April 24

▲ AISI reports that scheduled steel operations this week will be 100.3 per cent capacity which is equivalent to 1,912,000 net tons compared with 1,906,300 tons a week ago. This is a new high record.

▲ The Kaiser Steel Corp. took over ownership and operation of the Utah Fuel Co., one of the largest producers of bituminous coal west of the Mississippi.

April 25

▲ The American Institute of Steel Construction reported that total bookings of fabricated structural steel for March were 187,949 tons, the highest for two years. Shipments in March were 152,812 tons, leaving a backlog of 556,416 tons.

April 26

▲ Inland Steel Co. reported that net income the first quarter of 1950 was $9,320,463 on sales of $97,533,218.

▲ Jones & Laughlin Steel Corp. reported net income for the first quarter of 1950 of $5,309,828 on net sales of $102,547,428.

▲ Crucible Steel Corp. reported net earnings for the first quarter of $759,451 after taxes.

April 27

▲ Ben Moreell, president of Jones & Laughlin Steel Corp., predicted that steel production in his plants will average about 100 per cent capacity for the rest of the year.

▲ Price of lead advanced ¼c to 11c a lb in New York.

▲ Truck and automobile sales for the first quarter of 1950 set a new record with 1,635,966 units.

▲ National Steel Corp. reported net earnings for the first quarter of 1950 of $13,434,454 after the usual deductions.

April 28

▲ Columbia Steel Co. is installing a single stand, 2-high temper mill at Pittsburg, Calif. for flattening hot rolled sheets received from Geneva.

▲ The Bethlehem Steel Corp. increased its quarterly common dividend from 60 to 75c. Net profits for the first three months of 1950 were $2.50 a common share compared with $3.29 a share in the first quarter of 1949.

▲ Price of scrap rose $1.00 a ton in Pittsburgh to $34.00 a ton.

April 29

▲ Department of Commerce reported that unemployment dropped 12 per cent in April to 3,515,000, down 608,000 from March. Employed rose to 58,688,000 or up 1,117,000.

▲ Commerce Department reported that manufacturers booked more business in March than in any month since the war.

▲ The International Tin Study Group released details of a proposed five year tin agreement to be submitted to the United Nations under which exports from producing countries would be allocated to consuming nations.

▲ The Jones & Laughlin Steel Corp. is planning to install a continuous butt weld mill for production of small pipe in Aliquippa.

April 30

▲ Stockholders of the Portsmouth Steel Co. defeated a proposal sponsored by a dissident stockholders committee to liquidate the company and distribute the assets including $12,000,000 in cash. As a result the Cyrus Eaton group is in control and will continue to operate.

▲ United States Steel Corp. reported net earnings for the first quarter of 1950 of $49,217,742 or 7.8 per cent on sales. Expenditures for plant additions and replacements were $38,000,000 and net current assets of the corporation on March 31 were $492,035,991.

DESIGN LEADERSHIP

SQUARE D CONTROL CENTERS provide MORE control in the SAME space

SQUARE D CONTROL CENTERS have provided substantial space savings in 70% of recent installations. The compact design of Square D starters and circuit breakers permits side-by-side mounting through SIZE 3. Free standing vertical sections have mounting provisions for individual control units built to minimum heights based on 3" steps. Each section has 78" height available for units. SIZES 1 and 2 non-reversing starters are 12" high; SIZE 3 is 15" high.

The control center illustrated above shows typical Square D space economy. The following is incorporated in only 188" L x 90" H x 20" D:

SECTIONS 1 AND 2 *(left to right)*—three starters and one space for 75 H.P. motors.

SECTIONS 3 THRU 7—two-speed starters for five 15/3.7 H.P. and two 30/7.5 H.P. motors. Starters for five 30 H.P., four 10 H.P. and two 2 H.P. motors. Three 50A frame branch circuit breakers.

SECTION 8—Six 50A frame branch circuit breakers.

SECTION 9—Three reversing starters and one space for 7 1/2 H.P. motors. (Pilot lights and push-buttons are mounted in covers without increasing standard unit sizes.)

If Space Isn't Your Problem— consider these important features:

Plug-In starter units slide on guide rails at four corners. Spring backed, silver plated stab fingers grip round vertical busses.

Safety Disconnect handle mechanism locks both door and disconnect with one to four padlocks. On closing unit door, handle moves to indicate ON or OFF.

Wiring Channels at top, bottom and both sides of each section are fully front accessible.

Write for Bulletin 8938. Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

"Not a Single Solenoid Has Burned Out On Our Water Valves Since We Protected Them With FUSETRON dual-element FUSES"

"During the winter of 1948-49 solenoids on five of our water valves burned out due to freezing of the water.

"The replacing coils alone cost us about $50.00 but the labor and operating loss ran much higher.

"To prevent these losses we installed a Fusetron dual-element fuse to protect each coil.

"During the winter of 1949-50 we did not lose one single coil due to burnout — but we did blow quite a few Fusetron fuses.

"The cost of replacing these Fusetron fuses was nothing to the loss we would of had if they hadn't blown."

E. C. Willy, Chief Electrician
H. J. Kaiser Aggregate Plant,
Pleasant, California

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Fusetron DUAL ELEMENT Fuses

give 10-point protection

1 Protect against short-circuits.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

Fusetron DUAL-ELEMENT Fuses

Give All-Purpose Protection

because . . . The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Don't Risk Losses

One **burned out** solenoid
One **needless** shutdown
One **lost** motor
One **destroyed** switch or panel

may cost you far more than replacing every ordinary fuse with a **FUSETRON** dual-element fuse.

Mail the Coupon Now

for complete information about Fusetron fuses and their 10 point all-purpose protection.

FUSETRON is a trade-mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON Dual-Element FUSES.

Name_____

Title_____

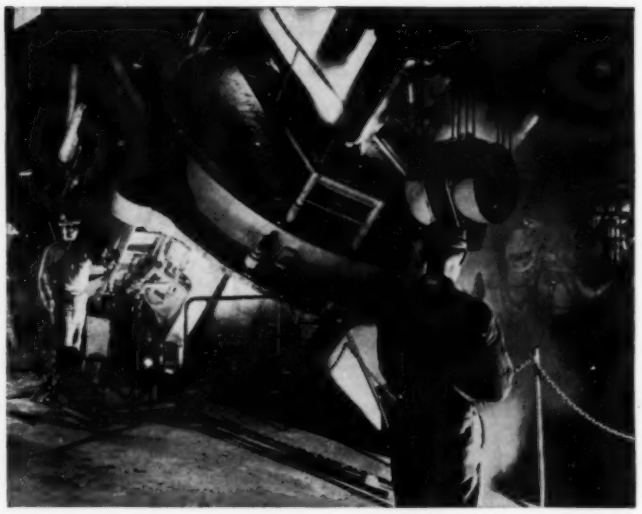
Company_____

Address_____

City & Zone_____ State_____ 550

How Would You

ARC FURNACE OVERLOADS CLEARED IN 8 CYCLES BY A-C BREAKERS



Exclusive *Ruptor* Device Quenching Chamber Reduces Contact Burning, Oil Deterioration; Enables Oil Breakers to Double as Arc Furnace Switches, Back-Up Circuit Breakers

WHEN A SEVERE CURRENT SURGE develops on your electrical system, you have to cut it off, and fast! Fault and overload currents up to 72,000 amps are cleared within *eight* cycles by these modern Allis-Chalmers *Ruptor* device equipped oil circuit breakers.

Arc quenching *Ruptor* device carries current while silver plated main contacts open — minimizing contact burning. Then, *Ruptor* device contacts separate and resultant arc generates gas pressure, forcing swirling oil into arc path to extinguish it. Lightning fast action and low oil quantity in chamber keep oil carbonization and deterioration down.

Double protection is provided by two *Ruptor* devices in series on each pole. Fifteen years of wide *field* use have proven the principle, design and construction of the exclusive Allis-Chalmers *Ruptor* interrupting device.

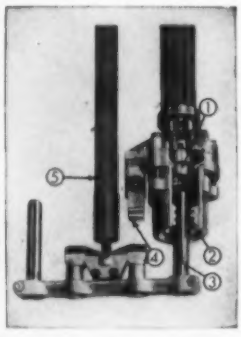
Ruptor device equipped oil circuit breakers can perform *double duty* for your arc furnace. These compact, easily installed units can readily handle routine arc furnace switching duty. And, in addition, their high interrupting capacity enables them to furnish back-up protection for transformer primary shorts or other heavy short circuit currents.

A qualified A-C steel mill representative is near you, ready to explain how *Ruptor* device equipped oil circuit breakers can be applied profitably to *your* operations. Call your nearest A-C sales office for further information.

A-3057

ALLIS-CHALMERS, 1020A SO. 70 ST.
MILWAUKEE, WIS.

Ruptor and *Unitop* are Allis-Chalmers trademarks.



Ruptor device cut away to show: (1) stationary tulip type contact (2) helical throat passage (3) bayonet movable contact (4) main current carrying contacts (5) impregnated maple lift rod.

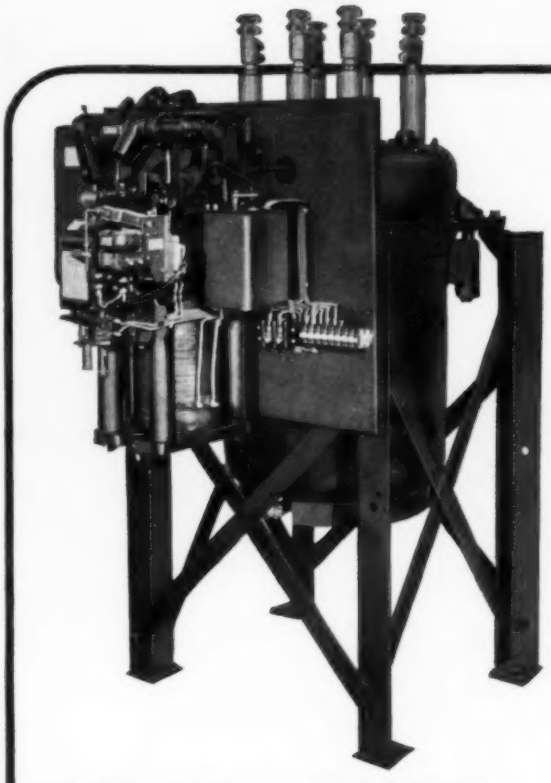
Portable tank lifter allows one man to lower tank to floor for maintenance check. With breaker open, main current carrying contacts and *Ruptor* device movable bayonet contact may be inspected. Oil can be drained and filled without having to lower the tank.

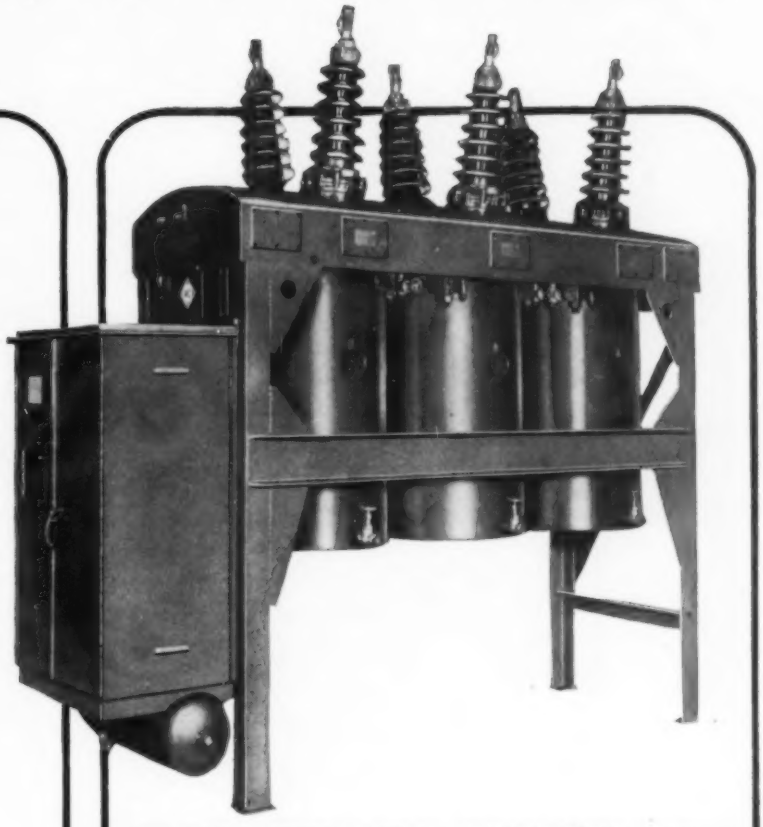
Removing four bolts on *Ruptor* device throat assembly exposes stationary tulip type contact. Tank does not have to be moved from lowered position for this maintenance check.

ALLIS-CHALMERS

Power, Electric, Processing Equipment for Iron and Steel

Stop 72,000 AMPS IN 1/8 SECOND?





TYPE DZ INDOOR OIL CIRCUIT BREAKER

Type DZ Breakers are rated 600 to 2000 amperes and from 7.2 to 13.8 kv. Interrupting ratings range from 100,000 to 500,000 kva. They are furnished in the following mounting styles: self supporting framework for enclosed room, cell, flat surface, cubicle, switch house, metal-clad switching equipment, and safety enclosed switchboard.

The oil tight mechanism is completely enclosed. All mechanism parts are steel, made rust resistant by *Parkerizing* process. Impregnated *Bakelain* bushings are practically impervious to moisture and oil.

Silver plated current carrying contacts need no dressing. Arcing contacts are of special arcing alloy. Hydraulic shock absorbers decelerate moving contacts near end of opening stroke. To allow for collection of dust and grime on insulation in arc furnace switching, use breaker at one step higher voltage rating. Write for Bulletins 71B6129D, 71B6179C for details.

				Interrupting Rating		
Type	Rated Kv	Rated Amps	Max. Design Kv	Kva	Amps at Rated Volts	Max. Amps
DZ-40-B	7.2	600 1200 2000	8.25	100,000	8000	25,000
DZ-60-B	13.8	600 1200	15.0	150,000	6300	22,000
DZ-100-B	13.8	1200	15.0	250,000	10,600	36,000
DZ-200-B	13.8	1200 2000	15.0	500,000	21,000	44,000

TYPE FZO-150 OUTDOOR OIL CIRCUIT BREAKER

Type FZO-150 Breakers are rated from 600 to 2000 amperes and from 14.4 to 46 kv. Interrupting ratings range from 500,000 to 2,500,000 kva . . . or to 72,000 amperes maximum interrupting current.

These breakers are equipped with the *Unitop* all-welded steel, one piece top frame for all three poles — another exclusive Allis-Chalmers feature. The smooth, compact exterior has a minimum of crevices to collect dust or invite corrosion. Porcelain bushings are oil filled and sealed. External conduits are eliminated, sealed ducts being used.

Type FZO-150 breakers furnished with mechanical and electrical trip free pneumatic operation as standard, solenoid operation optional. In arc furnace switching, use a breaker of next higher voltage rating. Write for complete details; on FZO-150, Bulletin 71B6421A — on FZO-50, Bulletin B6003A.

				Interrupting Rating		
Type	Rated Kv	Rated Amps	Max. Design Kv	Kva	Amps at Rated Volts	Max. Amps
FZO-150-15	14.4*	1200 2000	15.5	1,000,000 1,500,000	40,000 60,000	48,000 72,000
FZO-150-23	23.0	1200	25.8	500,000	12,600	24,000
FZO-150-34	34.5	600 1200 1200 2000	38.0	500,000 1,000,000 1,500,000 2,500,000	8400 17,000 25,000 42,000	12,600 25,000 38,000 60,000
FZO-150-46	46.0	600 1200	48.3	500,000 1,500,000	6300 19,000	7200 22,000

*All 14.4 kv Type FZO-150 breakers include 23 kv bushings. 3000 and 4000 Amps A.S.A. standard ratings—Type FZO-50.

F·E·I·

Furnaces ... THE ALL-IN-ONE BUY for GALVANIZING

Kettle Life More Than Tripled with F.E.I. *Patented Settings*

Out of Furnace Engineers' more than 30 years experience has come the ALL-IN-ONE BUY for galvanizing that sets new records for high production at low cost.

UNIQUE DESIGN . . . NO STACK REQUIRED. In a typical Pipe Galvanizing plant, kettle life was increased from 20,000 to 70,000 tons, thanks to F.E.I. patented baffle type burners and eductor, requiring no costly stack.

AUTOMATIC CONTROL . . . FLEXIBILITY. F.E.I. *fully automatic control* insures uniform temperature, flexible high and idling operation, minimum fuel consumption, increased output. Loss from shut-downs, formerly a major item, is now negligible. F.E.I. service is complete—from original analysis of your needs through to actual production.

SHEETS · TUBES · METALWARE

Top photo: **F. E. I. equipment for galvanizing sheets.**

Lower photo: **F. E. I. installation for galvanizing metalware.**

WRITE FOR THIS BULLETIN
It tells how F. E. I. technique has made ordinary methods obsolete.

Furnace Engineers, Inc.

F. E. I. Building • 1551 West Liberty Avenue • Pittsburgh 16, Pa.

Industry News...

STATE OF PENNSYLVANIA INAUGURATES MOBILE AIR POLLUTION LABORATORY

▲ Pennsylvania's new air pollution and industrial hygiene mobile laboratory, the only one of its type in the country, has just been placed in service by the state's Bureau of Industrial Hygiene.

Designed and supplied to the state by Mine Safety Appliances Co., Pittsburgh, Pa., the laboratory is equipped with more than 25 scientific devices for field sampling and quantitative and qualitative analyses of atmosphere in industrial communities and factories.

The laboratory will play an important part in the state's effort to keep the atmosphere in industrial communities free from hazardous or annoying fumes, dusts and gases.

The laboratory is in a closed route van type body with specially designed built-in work benches, cabinets, racks, and storage compartments.

Because some surveys will be made in locations without power or water supplies, the laboratory has been made self-sufficient for these necessities. It is equipped with a gasoline motor-driven generator for electrical service, a 30-gallon fresh water tank, 10-gallon distilled water tank and two liquefied petroleum gas tanks to supply fuel for Bunsen burners. The laboratory also has a weathertight connection for an outside power source. A separate ventilating fan is installed.

Quantitative and qualitative analyses of air samples can be made quickly on the spot after the samples are obtained.

All equipment is individually compartmentalized in rubber-cushioned racks or drawers.

One of the principal devices is an electrostatic sampler with which laboratory technicians can sample atmospheres for all types of particulates, including dust, fumes and smoke resulting from many industrial processes.

Operating on the principle of electrical precipitation, this sampler has a portable head which contains an ionizing electrode, a collecting tube and motor-blower assembly that provides for a flow of 3 cfm. Particles present in the incoming air are charged by the electrons and are deposited on the collecting tube. Determinations then can be made by weight without removing the sample from the tube, or further tests can be undertaken by extracting the samples.

Two portable impingers also are part of the laboratory equipment. These are used to collect dust samples in out-of-the-way locations and are operated by a hand crank.

Special instruments were developed for separate detecting of hazardous gases or fumes such as carbon monoxide, chromic acid mists, nitrogen dioxide, benzol and hydrogen sulphide also are among the equipment.

Since weather conditions have an important bearing on air pollution, the laboratory will have a full complement of meteorological instruments.

Because the laboratory is the first of its kind ever constructed, state officials expect to add more equipment as specialized problems arise. A Geiger counter may be obtained for investigation of problems involving radioactivity.

However, for practical field use in pollution and similar industrial hygiene work, the laboratory with its equipment is described as being complete and self-contained.

CONTINUOUS GALVANIZING LINE COMPLETED AT GARY

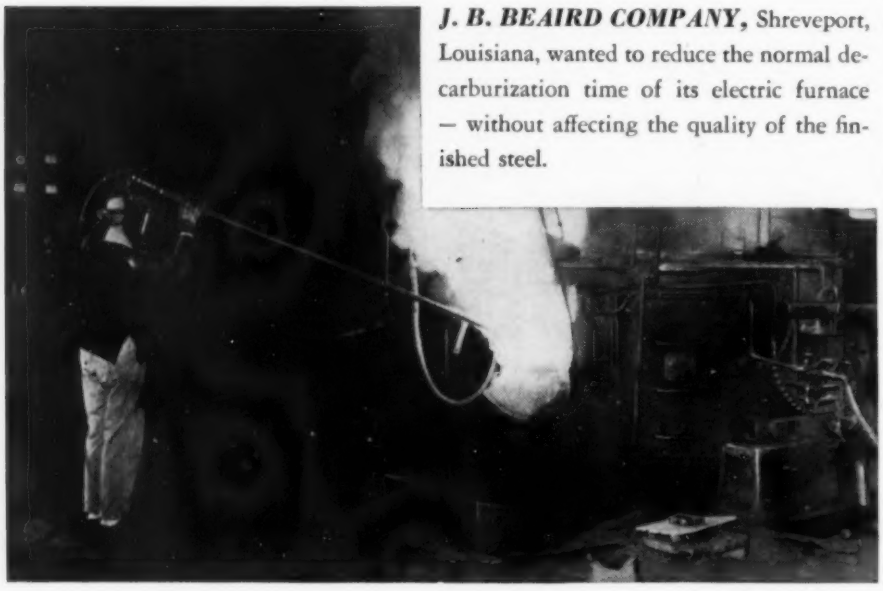
▲ A new, 600-ft long galvanizing line which makes it possible to continuously heat treat and galvanize coils of cold-rolled steel sheets has been completed at Gary sheet and tin mill of Carnegie-Illinois Steel Corp., Gary, Ind.

Much brighter finishes in a tight-patterned spangle are produced on sheets rolling off this new line

GE EXHIBIT TRAIN TO TOUR AMERICA

The "More Power to America" special, the General Electric apparatus department's 10-car exhibit train, hauled by a modern 4,500-hp, two-unit diesel-electric locomotive, is filled with exhibits of more than 2,000 of the latest products, systems, and techniques for producing and utilizing electric power. The train will visit principal cities of the United States.

Oxygen cuts electric furnace decarburization time . . . saves power



J. B. BEAIRD COMPANY, Shreveport, Louisiana, wanted to reduce the normal decarburization time of its electric furnace — without affecting the quality of the finished steel.

George Bellew, Airco Technical Sales Representative, was called in to determine what effect the introduction of oxygen in the molten bath would have on refining time. In each of the three trial "heats" oxygen was run just below the slag metal interface.

Several of the advantages of using oxygen in these "heats" were: greater alloy recovery . . . reduced time and power consumption . . . electrode cost per ton lowered . . . elimination of ore handling and storage . . . increased melting rate . . . increased bath temperatures . . . faster carbon elimination.

To date the J. B. Beaird Company has conducted tests on 200 more "heats" — and is highly pleased with the results.

The use of oxygen for decarburization has now become standard practice.

For more information about this unique decarburization process, or Technical Sales help for your particular problem, get in touch with your nearest Airco office.

AIRCO **AIR REDUCTION**

Offices in Principal Cities

TECHNICAL SALES—ANOTHER AIRCO PLUS-VALUE FOR CUSTOMERS

which is capable of galvanizing coils of steel at a rate of 300 fpm in widths up to 48 in.

The annealing or heat treating furnace—an integral part of the new line—is heated by electrical elements much like the ordinary toaster. Coiled steel passing through the furnace emerges directly into a bath of molten zinc.

Replacing the older, conventional method of galvanizing sheets the new line boasts an annual production capacity of 60,000 tons. Galvanized sheets are sold to the roofing and metal fabricating industries.

PORCELAIN ENAMEL SHOWS STEADY INCREASE

▲ Shipments of porcelain enameled steel fixtures amounted to $11.7 million during the fourth quarter of 1949, according to the Porcelain Enamel Institute. With over 400,000 units, manufacturers of porcelain enameled steel fixtures accounted for 18 per cent of the total plumbing units shipped.

Based on latest Bureau of Census reports, these figures reflect a steady increase in shipments since the beginning of 1949. Fourth quarter shipments were approximately 18,000 units and $60,000 ahead of those of the third quarter. Compared to first quarter reports from the 57 major plumbing equipment manufacturers, steel fixtures gained over $4-million, or about 50 per cent.

The bulk of the gain came from porcelain enameled steel kitchen sinks, with steel bathtubs and steel lavatories also registering increases.

POST ELECTRIC NAMED WESTINGHOUSE AGENT

▲ The appointment of the Post Electric Co., Chicago, Ill., as industrial agent for the Westinghouse Electric Corp. has been announced. Don L. Orton, vice-president of Post Electric stated that this appointment would supplement and substantially broaden the construction, engineering and maintenance service his company renders to industry in the Chicago area.

Applying particularly to industrial motor and control applications, this appointment makes available to the

...Use HOMESTEAD-REISER

FULL PORT *Self-Seald* LUBRICATED PLUG VALVES

. . . the Lowest Priced, Full-Port-Area Plug Valves In Their Rated Working Class

If you're using a venturi (restricted-port-area) valve with an opening of say, 60% standard pipe area, you are operating at reduced line pressure. To be sure of nearly full line pressure, you must use a larger size venturi, which of course means a higher priced valve . . . perhaps as much as 30% higher!

For example: **A 2½" Homestead-Reiser has a 100% full-port-area, or 4.78 sq. in. The 2½" size in 60% venturi pattern has only 2.87 sq. in. port area. To approximate the full-port-area of a 2½" Homestead-Reiser valve, a 3" venturi must be used. And even then you'll have less than Homestead-Reiser's full-port-area.**

In the light of this evidence doesn't it stand to reason that Homestead-Reisers with their 100% full-port-area are sound economy?

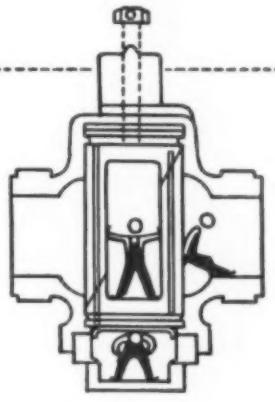
Truly, from the standpoint of both first cost and length of service, they are the lowest priced, full-port-area lubricated plug valves in their rated working class!

←For complete information, write for Catalog 39, Section 5. We'll mail it to you promptly.

HOMESTEAD VALVE MANUFACTURING CO.

"Serving Since 1892"

P.O. Box 21 **Coraopolis, Pa.**



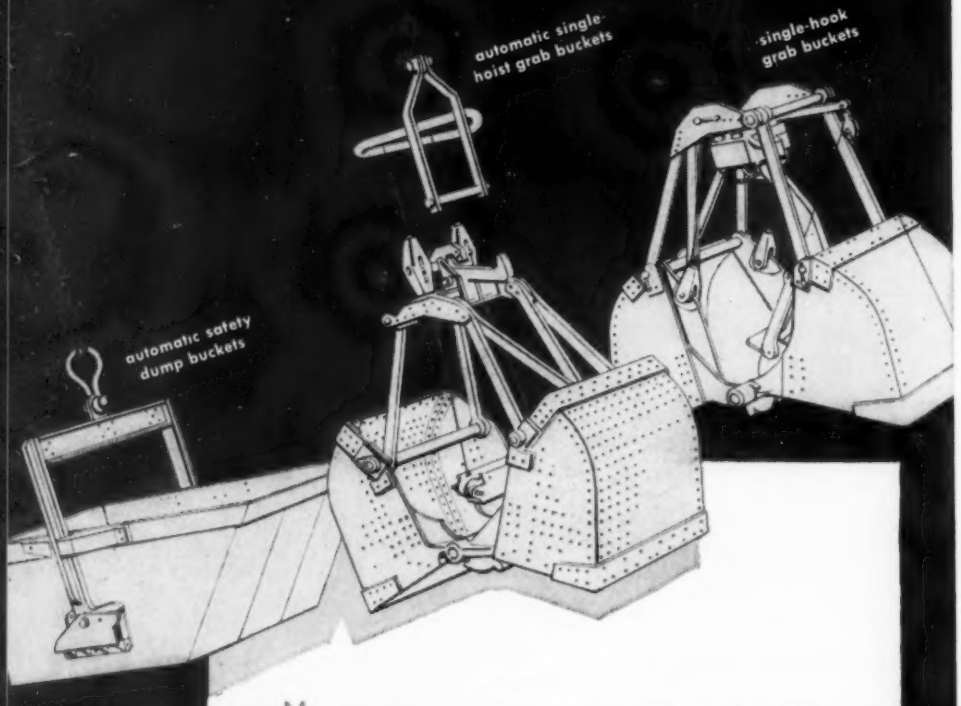
"SELF-SEALD" MEANS

. . . that in addition to a full-port lubricant seal the wedge-action of the plug under line pressure, forces the finished surfaces of the plug outward and constantly presses them against the seating surfaces of the body, thus keeping them always in intimate contact. The plug automatically adjusts itself for wear, assuring extra long life, maximum leakless service and lubricant economy.

dependable*

is a word to describe

BROSIUS BUCKETS



*Dependable means trustworthy or reliable, all of which aptly describes Brosius Buckets, and here's why: Brosius Buckets are sturdily built of heavy steel forgings, castings and plates and all parts are oversized for extra wear. Design has been purified to the point of maximum practicality and simplicity of operation. Many Brosius Buckets have been in operation for more than thirty years and they aren't ready for replacement yet. If you want a bucket you can depend on to suit your purpose and last your lifetime, write to Brosius for details and prices.

Edgar E. BROSIUS Company Inc.

SHARPSBURG • PITTSBURGH 15, PA.

European representative: Brassert & Co., Geneva, Switzerland

Post Electric Co. the repair facilities of Westinghouse's maintenance and repair department which are considered to be among the finest and most complete in the Middle West.

TRABON ANNOUNCES SALES REPRESENTATIVES

▲ Trabon Engineering Corp., Cleveland, Ohio, announces the appointment of three sales representatives. The firms appointed are Kendall Engineering Sales Co. of Milwaukee, Wisc.; Grant Watson Construction Co. of Denver, Colo.; and Engineering Associates, Omaha, Neb.

MATHEWS CONVEYOR MOVES NEW YORK SALES OFFICE

▲ Mathews Conveyer Co., Ellwood City, Pa., has announced the change of their New York City office address to: Room 402, Chanin Building, 122 East 42nd Street, New York 17, New York.

ESTABLISH SHOW ROOM FOR INDUSTRIAL TRUCKS

▲ A new showroom and sales office for Automatic Transportation Co. electric industrial trucks has been opened by the Lyall N. Crissman Co., 314 Boulevard of the Allies, Pittsburgh, Pa.

In approximately 3,500 sq ft of space, the Pittsburgh representative will maintain sales facilities, handle service parts and display electric industrial trucks.

The Crissman Co.'s former business address was 2006 First National Bank Building, Pittsburgh, Pa.

BLISS APPOINTS NEW PITTSBURGH AGENT

▲ E. W. Bliss Co. announces the appointment of the Steel City Tool & Machinery Co., Inc., 1014 Plaza Building, Pittsburgh, Pa., as sales representative for Bliss mechanical and hydraulic presses in portions of Western Pennsylvania and southeastern Ohio.

Coincident to this move, Bliss is closing its sales office at Pittsburgh. George Vassily, sales engineer in the Bliss Pittsburgh office, has joined the Steel City sales engineer-

ing staff and will continue to service Bliss customers in this capacity.

Previously a dealer for Bliss hydraulic machinery in substantially the same territory, the Steel City Tool & Machinery Co. now has expanded its coverage to include Bliss inclinable, straight side, enclosed, toggle and many other types of mechanical presses.

The territory covered for Bliss by the Steel City Tool & Machinery Co. is defined as including all counties in Pennsylvania west of the eastern boundary of Potter, Clinton, Centre, Huntingdon and Fulton Counties with the exception of Erie and Crawford Counties; and the following counties in Ohio: Washington, Morgan, Monroe, Noble, Guernsey, Belmont, Harrison, Jefferson and Carroll.

RUST BUILDS FURNACES FOR ITALIAN STEEL MILL

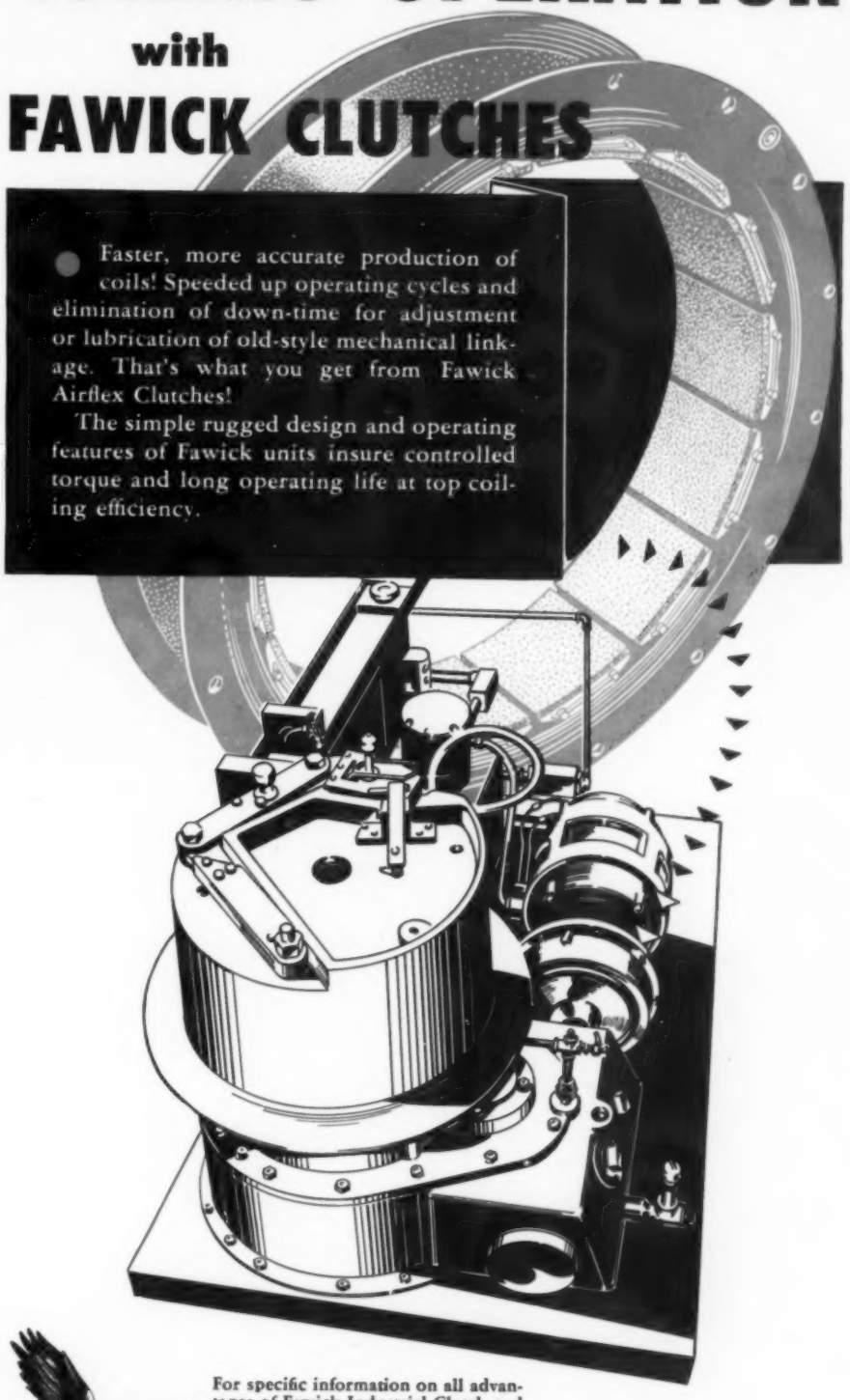
▲ Rust Furnace Co., Pittsburgh, Pa., will design and furnish complete engineering services for a continuous billet heating furnace to be installed at the Bagnoli (near Naples, Italy) Works of Ilva Alti Forni e Acciaierie d'Italia, Genoa, Italy, under contract with Morgan Construction Co., Worcester, Mass.

The furnace, a Rust double-zone fired billet heater, will have a capacity of 60 tons per hour and will serve a rod and merchant mill. Rust will also furnish the combination gas and oil burner equipment necessary for the furnace.

COLORADO FUEL & IRON MOVES EXECUTIVE OFFICE

▲ Colorado Fuel & Iron Corp. announced that the corporation has taken a long term lease on the entire 14th floor of the new 25-story air conditioned Uris Brothers Building now under construction in New York, N. Y. The corporation will move to its new quarters early next year when the building at 575 Madison Avenue is completed. The new space, totaling 15,600 sq ft, will be used as the executive office of Colorado Fuel and Iron Corp. and as the executive office and New York district sales office of its Wickwire Spencer Steel division. The corporation operates eight plants and numerous iron and coal mines.

FASTER, MORE ACCURATE COILING OPERATION with FAWICK CLUTCHES



Faster, more accurate production of coils! Speeded up operating cycles and elimination of down-time for adjustment or lubrication of old-style mechanical linkage. That's what you get from Fawick Airflex Clutches!

The simple rugged design and operating features of Fawick units insure controlled torque and long operating life at top coiling efficiency.

For specific information on all advantages of Fawick Industrial Clutch and Brake Units, write to the Main Office, Cleveland, Ohio, for Bulletin 300.

All desirable clutch characteristics are built into Fawick Airflex units

FAWICK Airflex CO., INC.
9919 CLINTON ROAD CLEVELAND 11, OHIO

FAWICK CLUTCHES = + + + = PEAK EFFICIENCY
AXIAL CONTACT 360° RADIAL CONTACT SHOCK ABSORPTION CONTROLLED TORQUE

GIANT ORE CARRIER MAKES MAIDEN VOYAGE

Inland Steel's giant new ore carrier, the "Wilfred Sykes", largest ship ever built on the Great Lakes, left Lorain, Ohio, on its maiden voyage on April 20. The ship, 678 ft in overall length, is built to carry a record cargo of 20,000 long tons at intermediate draft and 21,500 long tons at summer draft. It will have the greatest speed of any ore carrier on the lakes—16.5 mph loaded, 17 light. Also, it has the most powerful engines of any ore carrier—7,000 hp. The carrier weighs more than 7,500 tons without cargo and will weigh more than 28,800 tons loaded.

$10,000,000 IS SPENT ANNUALLY ON STREAMS

▲ The steel industry spends about ten million dollars annually in keeping clean the streams it uses, according to the American Iron and Steel Institute. In addition, the industry has more than ten million dollars invested in equipment to purify its major waste liquid, "used pickle liquor."

Pickle liquor is an acid bath used to remove oxide scale from such products as black plate for tinning, wire and sheet and strip. Recognizing that streams must function for public health, drainage, navigation and recreation, the steel industry renders harmless before disposal most of the 600 million gallons of waste pickle liquor used each year. This compares with six billion gallons of community sewage released to the nation's waterways daily, 40 per cent of which is not chemically treated.

Dust catchers, and in some cases electronic precipitators, are used to control flue dust from blast furnaces. This expensive equipment is effective in keeping solids from being carried into streams with waste cooling water.

Waste from coke ovens contains phenol, a powerful caustic poison. Steel plants frequently use the phenolic waste water from coke plants to quench hot coke after it is pushed from the ovens, thus keeping the phenol from the streams.

Oil escaping from steel plants into streams is eliminated by preventive measures within the mills, involving in some cases the installation of an oil skimmer.

There is, as yet, little or no financial return on the investment the steel industry has made in helping to prevent stream pollution.

RCA APPOINTS ERIEZ AS DETECTOR DISTRIBUTOR

▲ Radio Corporation of America, announced that the Eriez Manufacturing Co., Erie, Pa., has been appointed distributor for RCA electronic metal detectors. Eriez will handle all sales in the United States and Canada.

EF
GAS-FIRED
OIL-FIRED
and ELECTRIC
FURNACES
for
AGING
ANNEALING
BRAZING
CARBON RESTORATION
CARBURIZING
CERAMIC DECORATING
DRAWING
HARDENING
HOMOGENIZING
MALLEABLIZING
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SPECIAL ATMOSPHERE TREATMENTS
A SIZE AND TYPE OF FURNACE FOR EVERY PROCESS PRODUCT OR PRODUCTION

BRIGHT ANNEALING AND NORMALIZING STEEL STRIP *Continuously*

● EF continuous annealing and normalizing furnaces subject the entire length of the coil to exactly the same time and temperature cycle, producing extreme uniformity of grain size, resulting in superior qualities for deep drawing.

These furnaces shorten the annealing and normalizing cycle – and reduce the tonnage of material in process. Tension on the strip, the speed of travel and the atmosphere in the furnace are accurately controlled, producing the exactly desired surface finish and physicals – day after day. Capacities to meet any requirement.

THE ELECTRIC FURNACE CO.
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES
Salem - Ohio

take a new look at *Continental*

MERCHANT MILLS

Continental

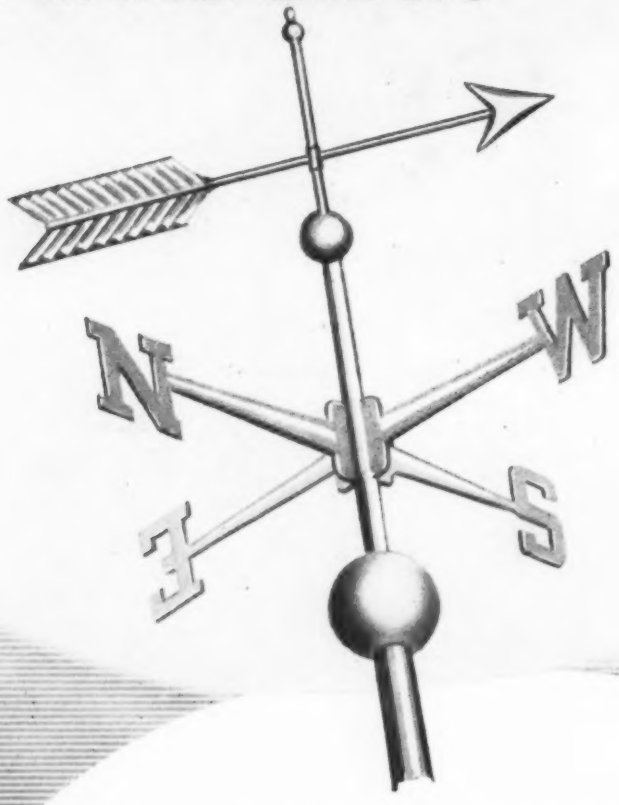
FOUNDRY & MACHINE CO.

CHICAGO · PITTSBURGH

Plants at: E. Chicago, Ind.; Wheeling, W. Va.; Pittsburgh, Pa.

Rolling Mills and Equipment
Iron and Steel Rolls
Carbon and Alloy Steel Castings

..whichever way the wind blows



. . . a modern Morgan rolling mill will help you meet the strongest competition . . . whether the competition is in price, quality or quantity . . . help you to develop new markets . . . help you to earn a fair return on your investment.

MORGAN CONSTRUCTION CO.
WORCESTER, MASSACHUSETTS

Rolling Mills - Morgoil Bearings - Wire Mills
Regenerative Furnace Control - Air Ejectors

English Representative: International Construction Company
56 Kingsway, London, W.C. 2, England

RM-27

The RCA detector will discover any metal that becomes embodied in materials being processed. It warns of the foreign body by bell, light, etc., and can also be set up to halt conveyor lines.

WHITING PURCHASES CONVEYER FIRM

▲ Whiting Corp., Harvey, Ill., announced that it has taken over the belt and chain conveyor business formerly operated as the Coburn-Foster Conveyor Co., Chicago, Ill.

The conveyor equipment will be manufactured at the Whiting plants at Harvey, Ill., and Los Angeles, Calif.

SHEET AND TUBE BUYS HILLMAN COAL MINE

▲ Negotiations have been consummated whereby Hillman Coal & Coke Co. has disposed of its Ontario Mine, located near Ellsworth, Washington County, Pa., to Buckeye Coal Co., a subsidiary of Youngstown Sheet and Tube Co. of Youngstown, Ohio, and Stelco Coal Co., a subsidiary of Steel Company of Canada, Ltd., of Hamilton, Ontario, Canada. The mine is being leased to a new operating company to be known as Ontario Mining Co., which company began operations on April 21, 1950.

NEW TUBE MILL HAS 100,000-TON CAPACITY

▲ A new mill of National Tube Co., McKeesport, Pa., has begun making pipe large enough to deliver 344 million cu. ft. of gas every 24 hours. The mill is geared to turn out annually 100,000 tons of electric welded and hydraulically expanded steel pipe, ranging up to 36 in. in diameter. Initial production is on an order for 30-in. size.

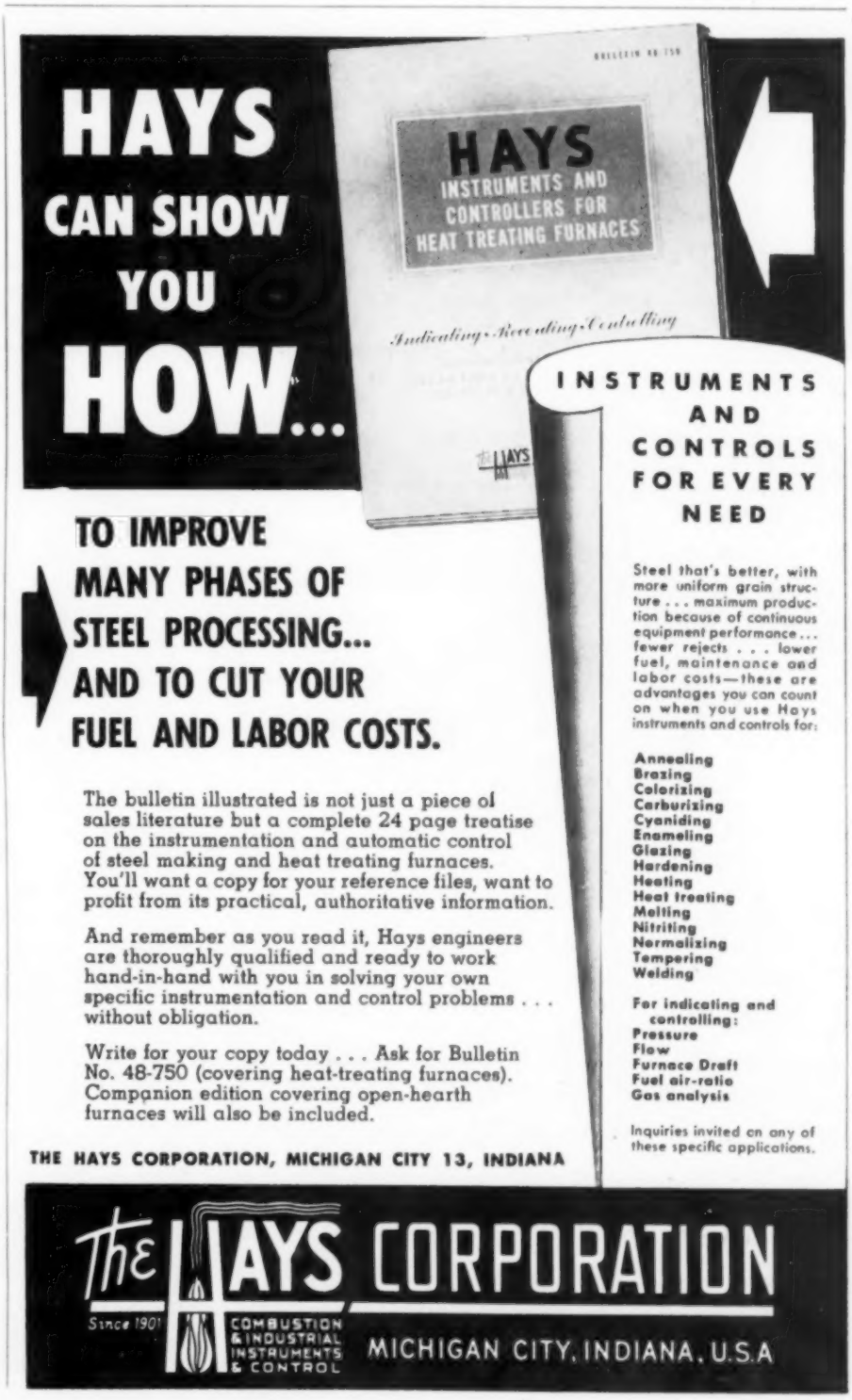
Sixteen big new machines are the major units of the mill, which convert wide, flat lengths of steel plate into welded pipe. The mill is expected to reach a normal production pace within two months, when its crew will be able to turn out a section of pipe 40 ft long every five minutes.

The new facilities make up a compact, streamlined production unit, involving the use of roller conveyors to move the heavy steel pieces of semi-finished pipe from machine to machine, much like the assembly line operation in automobile plants.

Among the major units in the production line are a 2000-ton hydraulic press, identified as a U-ing press because it forms the steel plate into a U shape, and an 18,000-ton hydraulic press that forms the U-shaped piece into its finished round shape.

Steel plates are shipped to the plant from the rolling mills at Homestead, Pa., works of Carnegie-Illinois Steel Corp. The mill can handle sizes ranging from 78½ to 110 in. wide, 40 ft long, and from ¼ to ½ in. in thickness.

The following major steps are employed in the new mill: The plates are transferred from the storage yard inside the mill building to a pair of end shears which even up the ends and then to a pair of plate planers which simultaneously plane both sides of the plate to proper width. Next, comes an edge form-


HAYS
CAN SHOW
YOU
HOW...
HAYS
INSTRUMENTS AND
CONTROLLERS FOR
HEAT TREATING FURNACES
Indicating • Recording • Controlling
INSTRUMENTS
AND
CONTROLS
FOR EVERY
NEED
TO IMPROVE
MANY PHASES OF
STEEL PROCESSING...
AND TO CUT YOUR
FUEL AND LABOR COSTS.
The bulletin illustrated is not just a piece of sales literature but a complete 24 page treatise on the instrumentation and automatic control of steel making and heat treating furnaces. You'll want a copy for your reference files, want to profit from its practical, authoritative information.
And remember as you read it, Hays engineers are thoroughly qualified and ready to work hand-in-hand with you in solving your own specific instrumentation and control problems . . . without obligation.
Write for your copy today . . . Ask for Bulletin No. 48-750 (covering heat-treating furnaces). Companion edition covering open-hearth furnaces will also be included.
THE HAYS CORPORATION, MICHIGAN CITY 13, INDIANA
Steel that's better, with more uniform grain structure . . . maximum production because of continuous equipment performance . . . fewer rejects . . . lower fuel, maintenance and labor costs—these are advantages you can count on when you use Hays instruments and controls for:
Annealing
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For indicating and controlling:
Pressure
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Inquiries invited on any of these specific applications.
The HAYS CORPORATION
Since 1901
COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROL
MICHIGAN CITY, INDIANA, U.S.A

Sixteen machines are the major units of the mill, which convert wide, flat lengths of steel plate into welded pipe.

ing machine which performs the initial curving of the sides of the plate, then the U-ing press, followed by the forming press. With the pipe shape then formed, the steel piece moves to the first welding operation. Two automatic machines weld the outside seam. Then it goes to a set of inside welders which welds the pipe together on the inside.

In the next operation, the pipe enters a machine which expands the diameter about ½ in. to the required measurement. The expansion is accomplished by means of water pressure, an operation that also increases the strength of the steel. The same machine tests the strength of the welded pipe under water pressure before it moves on to two facing machines which simultaneously face and bevel the ends.

After the facing operation, the pipe is passed along to inspection tables where it undergoes rigid examination before being loaded for shipment to the customer.

Auxiliary equipment in the new mill includes a 25,000-gallon water reservoir and an accumulator system to build up the high water pressure needed for the presses and for the expansion and testing operation.

ARMCO TO BUILD CULVERT PLANT

▲ Armco Drainage and Metals Products, Inc., a subsidiary of Armco Steel Corp., Middletown, Ohio, will construct a new $250,000 culvert manufacturing plant on a 20-acre site at Washington Court House, Ohio.

The new plant is being constructed because the growing demand for culverts has already exceeded the capacity of the nearest Armco Drainage and Metal Products plant which is at Middletown, Ohio.

Construction will be started as soon as contracts can be let. The plant building will cover over 26,000 sq ft of floor space. It will be fully equipped to make corrugated metal pipe for draining highways, railroads, and airports, and for making corrugated pipe arches. Equipment will also be provided for coating and paving culverts.

In addition an office building covering over 2,000 sq ft of floor space will be built.

CRANE BUILDERS Since 1903

BEDFORD CRANES

Capacities 5 to 150 Tons

Any Span or Lift
Send For Your
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Designed and Engineered to Meet Your Requirements

ELECTRIC OVERHEAD TRAVELING CRANES
GANTRY CRANES • STEEL DERRICKS
BUILT TO YOUR SPECIFICATIONS
STRUCTURAL STEEL • STEEL BUILDINGS

BEDFORD FOUNDRY & MACHINE CO.

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Gray
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DEEP CASE GEARS for Your COLD MILLS!

INDUSTRIAL GEAR MFG. CO. CHICAGO
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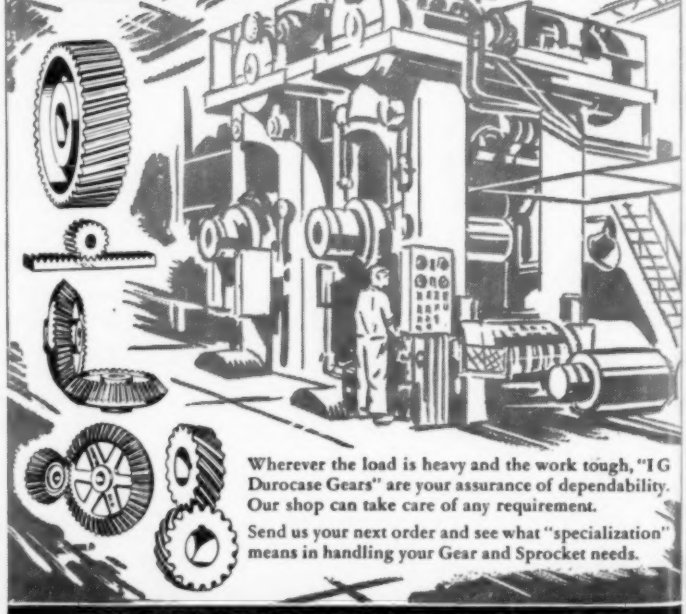
SERVE THE STEEL INDUSTRY



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GARY TIN PLATE CAPACITY TO HAVE SHARP INCREASE

▲ Carnegie-Illinois Steel Corp. has announced a program of improvements in the Chicago, Ill., and Gary, Ind., plants which will increase the tinplate producing capacity of the Gary sheet and tin mill by 120,000 tons annually. The new facilities to be built will increase this plant's annual tin plate capacity to 732,000 tons.

The two projects, which are interlocking, are scheduled to be completed and in operation by the end of 1950.

At the Gary sheet and tin mill a fourth electrolytic tinning line will be installed. This line will operate at 1,000 fpm.

Also at Gary sheet and tin, a continuous annealing furnace will be installed, the first of its kind in any Carnegie-Illinois plant. The continuous furnace will provide annealed plate for subsequent electrolytic tinning and give the annealed plate more consistent physical characteristics and better drawing qualities. The line will have conventional handling equipment at the points of entry and exit, electrolytic cleaning facilities and a furnace in which annealed strip is heated to the required temperature in a controlled atmosphere and then cooled.

At the South Chicago plant of Carnegie-Illinois, extensive improvements will be made on the 44 in. slabbing mill. This work will include replacement of mill tables, front and back, and replacement of one battery of soaking pits. Additional phases of the South Chicago work will be an extension on the stripper building at the No. 4 open hearth shop and purchase of additional cars to handle ingots from open hearth furnaces.

The South Works improvements are tied in with the sheet and tin projects and are specifically designed to provide additional slabs for processing at the Gary sheet and tin mill. The South Works improvements will increase the plant's 44-in. slab mill capacity by 150,000 tons to approximately 1,560,000 tons annually.

KOPPERS WILL BUILD 59 COKE OVENS FOR J & L

▲ Jones & Laughlin Steel Corp., Pittsburgh, Pa., has awarded Koppers Co., Inc., a contract to construct a new battery of 59 coke ovens at its Aliquippa, Pa., works.

The 59-oven battery will be of the Koppers-Becker underjet type, like two 106-oven batteries completed by Koppers at Aliquippa in recent years for J & L. Koppers also will construct an extension to J & L's present boiler plant, and will complete additions and alterations to the company's coal handling equipment.

Cost of the new ovens and the extending of J & L's steam generating and coal handling equipment will be in excess of $4,000,000, and all the work is expected to be completed early in 1951.

The 59 ovens will carbonize 1,433 tons of coal per day. When the new battery is completed, J & L will

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in the **HOT** *spots*

Soaking Pit Cranes
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Charging Cranes
Electric Furnace Cranes
Forge Shop Cranes
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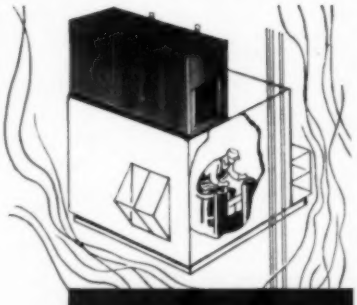

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REPEAT ORDERS from steel, iron and non-ferrous metal producers offer proof of the outstanding results where Dravo Crane Cab Coolers reduce fatigue and improve operator performance. It's worth your while to call or wire Dravo for case history details of these applications.

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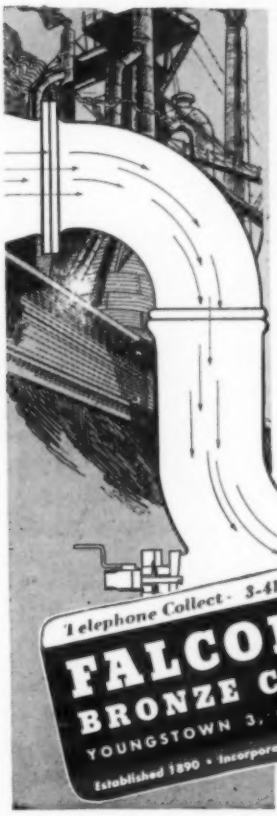
unpredictable needs of . . . .



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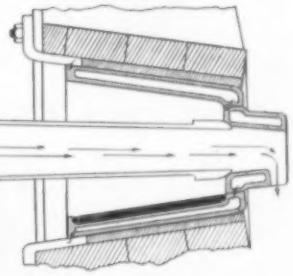

Illustrated is an installation of Falcon-produced Kinney Refractory-Lined Tuyere Cooler, U. S. Pat. App. Serial 530153, and Holzworth "Split Nose" Tuyere, U. S. Pat. 1,789,870.

have 352 coke ovens at its Aliquippa works, all but 81 of them of recent construction. This number of ovens will be capable of carbonizing 8,500 tons of coal per day.

NEW CONSULTING FIRM FOR STEEL INDUSTRY

▲ The formation of *Ramseyer & Miller, Inc.*, consulting engineers, was announced recently. The new firm with offices at 11 West 42nd St., New York, N. Y., will engage in general engineering practice, including design and reports on both old and new projects, with emphasis on heavy industry, particularly iron and steel.

Both Mr. Ramseyer and Mr. Miller who have for the past six years been associated with H. A. Brassert & Co., have recently returned from a 35,000 mile tour around the world. During this trip, they visited fifteen countries, including Australia, Malaya, India, Pakistan, Israel, Italy, Switzerland, France and Holland, and met with various government officials in these countries, private businessmen and industrialists, engineers and members of various university staffs.

Mr. Ramseyer is a graduate chemical engineer and metallurgist, and has been active in heavy industry since 1924; Mr. Miller, an electrical and civil engineer, with licenses to practice professional engineering in the states of New York, Pennsylvania, Ohio and Illinois, has been engaged in both light and heavy steel industry since 1928.

ARMCO IMPROVES OPEN HEARTH CHARGING

▲ Armco Steel Corp., Middletown, Ohio, has announced a new method for feeding open hearth furnaces with scrap metal and other raw materials. It is the first major improvement in charging open hearths since the advent of the charging machine in 1885. Because it promises increased steel output along with other advantages, the revolutionary development has drawn the attention of steel industry engineers all over the nation.

The new plan uses a system of hydraulic hoists which elevate cars or buggies filled with scrap metal and other raw materials, from the scrap yard level up to position in front of the furnaces. It will be installed at Armco's new open hearth department which is under construction here.

Standard practice is to move long lines of scrap-laden buggies to the furnaces on railroad tracks. This frequently results in the buggies blocking off nearby furnaces, causing delays which decreases the production rate.

Test runs made under simulated conditions have proved the value of the new method. Armco engineers who designed the new system estimate it will reduce the average of three hours time required to charge 150 tons of scrap metal into a furnace to about one and one-half hours. Another advantage of the new method is that it will permit a more even rate of operations by stock men who load buggies with scrap metal and other materials.

The first scrap-hoist charging system is expected to be in operation at Armco's East Works by the end of this year.

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Mill Shears, Mill Reduction Drives, Roll Lathes, Sheet Pack Carriers, Stretcher Levellers, etc.

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GRAY IRON CASTINGS

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Oakite Compound No. 33 is a great soak cleaner for metal parts of moderate size; and great for hand-swabbing on large parts. It removes heat scale, other oxides, smuts, welding residues and marking inks from steel and aluminum. It develops splendid paint adhesion.

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FREE For more information on Oakite Compound No. 33 write to Oakite Products, Inc., 19 Thames St, New York 6, N. Y.

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in these 74 years—tremendous experience, constant laboratory research, close study of industrial lubricant problems have resulted in the development of

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***LEADOLENE . . . the "I. P. Lubricant" (Indestructible pH-ilm) . . . for Industrial Needs**

. . . and one of our good customers recently DISCOVERED that they had better protection, and the consumption of Leadolene KLINGFAST was just *one-fifth* the quantity of a high grade lubricant they had been using previously—on enclosed table roller gear housings of a continuous plate mill. Leadolene KLINGFAST *can do a better protective job for you, too, more economically*, under such difficult conditions as climatic changes, excessive water and abrasive conditions. Our engineers will be glad to work with you.

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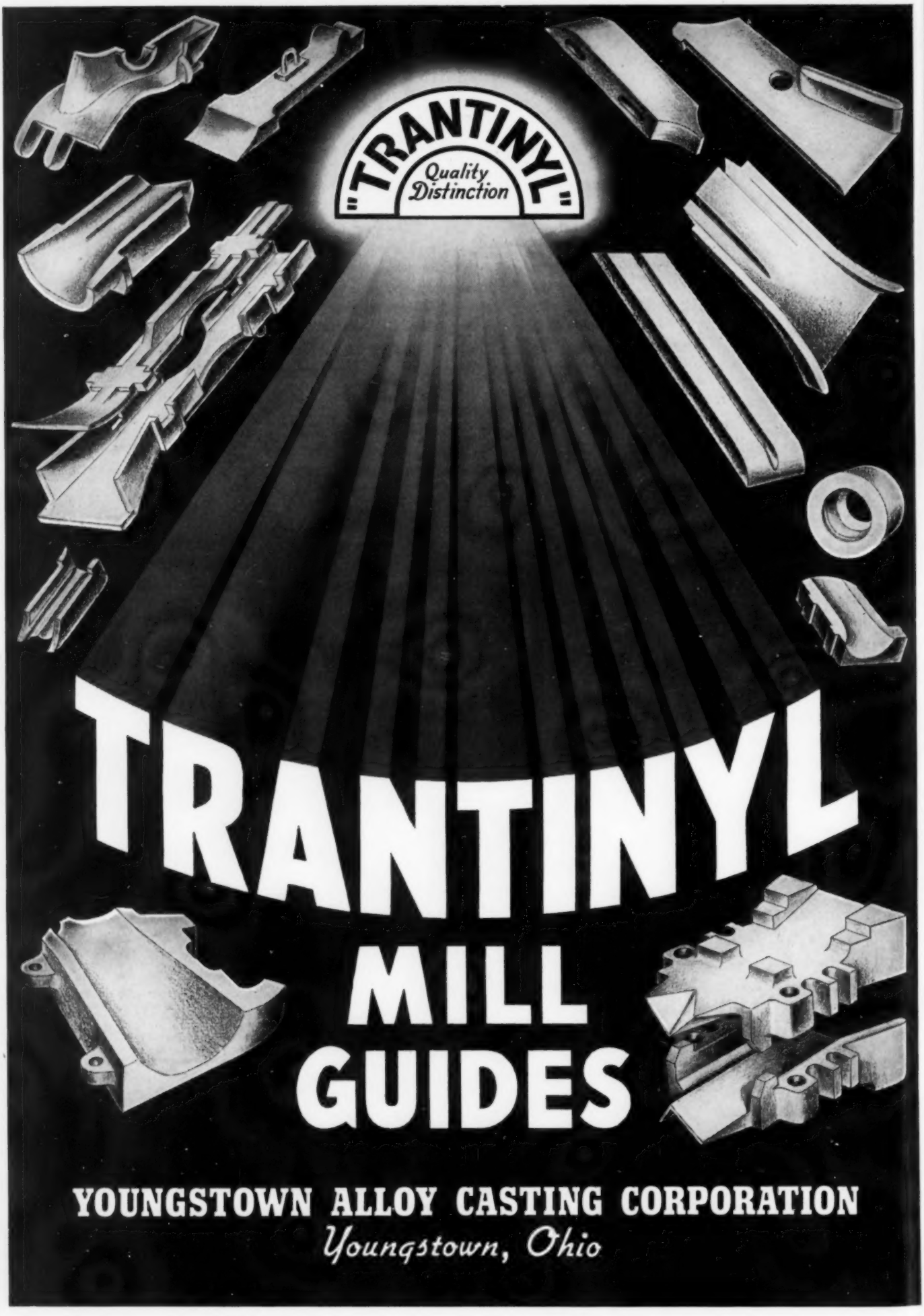
CHECK THESE 9 IMPORTANT FACTS

1. **EXTREME PRESSURE pH-ilm STRENGTH** of 50,000 lbs. per square inch minimum by "Timken" testing machine.
2. **ADHESIVENESS** in which affinity for steel and other metals develops maximum adhesion and prevents drippage or creeping. Retains a flexible coating in nature.
3. **WATER REPELLENCE** which retards washing off, creates a lubricating pH-ilm under moisture or water conditions.
4. **CORROSION PREVENTION** is an excellent protective coating in that it will not etch or corrode metals. Is never acidic.
5. **COMPOUNDED STABILITY**—Will not bleed or change physical condition within range of higher than usual temperatures for this type of lubricant.
6. **LOW TEMPERATURE FACTORS**—While having a solidifying action by decreased temperature as low as —40 F., it does not harden, crack or decrease in adhesion. The flexible coating withstands distortion of the application.
7. **ABRASIVE RESISTANCE**—Extremely high for a lubricant. Does not wipe off nor will be removed in handling by workmen's hands or gloves. Is extremely repellent to adhesion of scale, metallics and other forms of dusts or contamination.
8. Klingfast has remarkable corrosive resistance to salt or sea water, acidic vapors and solutions.
9. Klingfast can be removed by ordinary solvents such as kerosene, gasolene, naphtha, carbontetrachloride and similar substances but is highly impervious to lubricating oils and greases.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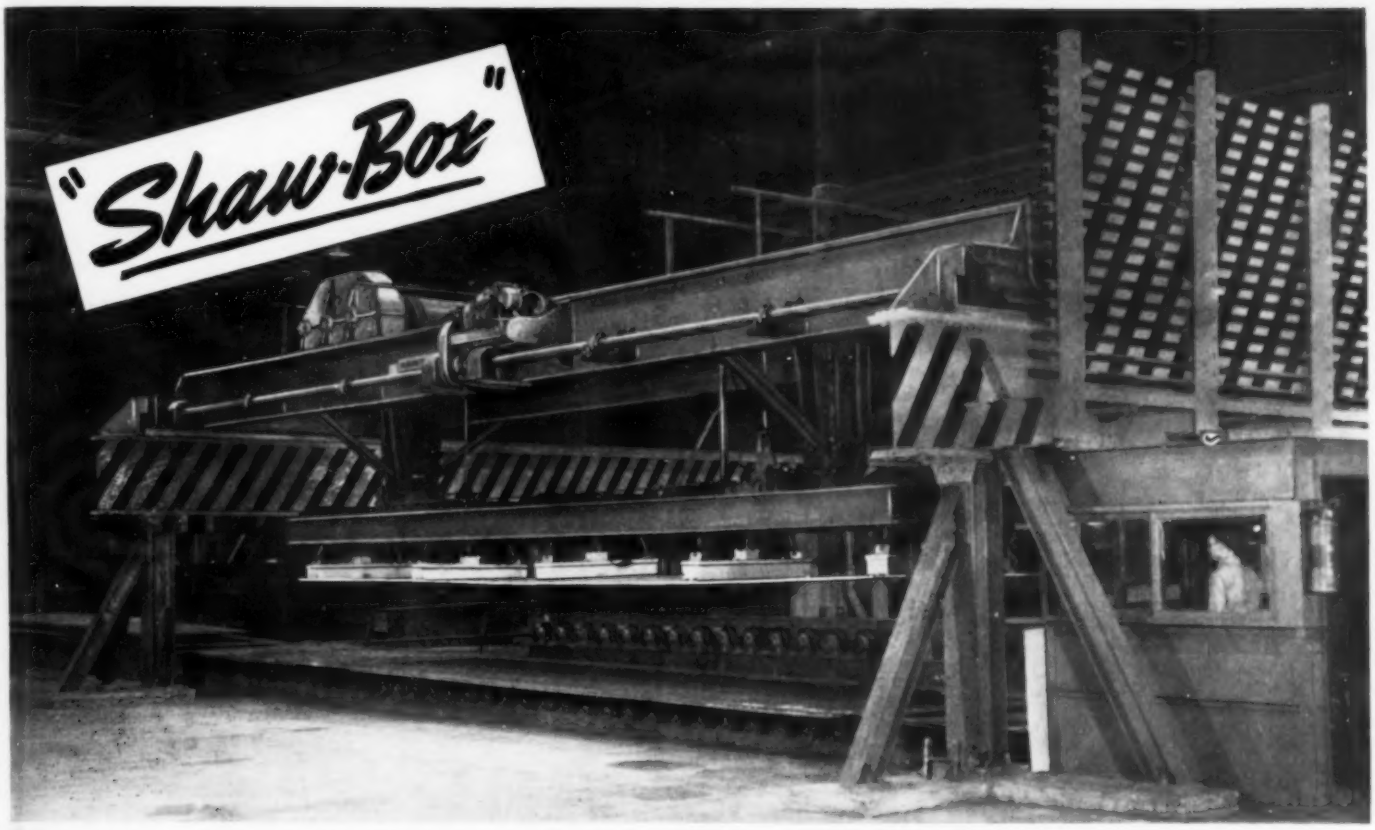


PLATE HANDLING CRANES

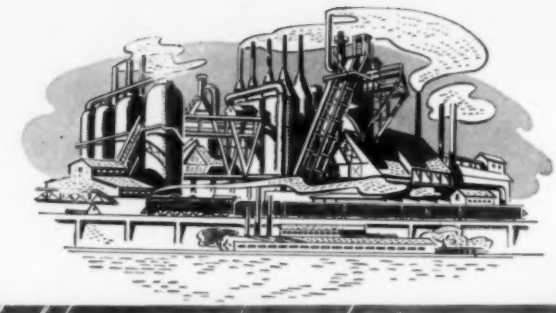
When your Plate Handling Cranes are "Shaw-Box," you utilize all the reliability, efficiency, and service that these cranes are known for throughout the steel industry. Plate Handling Cranes are a specialty with us, growing through years of study and field experience in designing and producing this type of equipment to fully meet the most severe and exacting mill service specifications.

Specialization in pioneering, designing, and producing Plate Handling Cranes has long been a "Shaw-Box" tradition. Working hand in glove with the steel industry, "Shaw-Box" research men and engineers have gained the intimate understanding of plate handling requirements that has developed features such as variable flux control — lifting magnets that discharge one plate at a time after picking up several — rope lifts instead of bars, with guides to restrict swing — and many other advantages for faster, dependable operation.

Even with these special features, engineering, construction, and design expense involved in building "Shaw-Box" Plate Handling Cranes is exceptionally low.

Be sure to send all your inquiries and specifications for Plate Handling Cranes and Gantries to "Shaw-Box."

MANNING, MAXWELL & MOORE, INC.
SHAW-BOX CRANE & HOIST DIVISION
MUSKEGON, MICHIGAN



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"National" ground anodes have been used for more than 15 years. They outlast any other material. You don't have to dig them up every few years. For highest efficiency, pack "National" graphite backfill material around each anode in the bed.

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Personnel News...

Frank Purnell was elected chairman of the board of directors for Youngstown Sheet and Tube Co., Youngstown, Ohio. Mr. Purnell first came with Youngstown Sheet and Tube in 1902 and he has been president of the company since January 1, 1930.

J. L. Mauthe was elected president of the Youngstown Sheet and Tube Co., Youngstown, Ohio. Mr. Mauthe was born at Turkey City, Pa., and graduated from Pennsylvania State College. He studied metallurgy and upon graduation from college became a blast furnace laborer for Carnegie Steel Co. at Duquesne, Pa. He moved from there to the position of an assistant superintendent of blast furnaces with National Tube Co. at McKeesport, Pa. In 1917 he joined Midvale Steel and Ordnance Co. as blast furnace superintendent and later was assistant superintendent of coke plant, then assistant superintendent of blast furnaces for the Illinois Steel Co. at Gary, Ind. In 1920 he went to Lorain, Ohio, as assistant superintendent of blast furnaces and in 1930 became assistant general superintendent of the Lorain Works of National Tube Co. In 1935 Mr. Mauthe came with Youngstown Sheet and Tube Co. He was appointed general superintendent of the Youngstown district in 1937 and in 1943 he was elected vice president in charge of all operations.

Alfred S. Glossbrenner was elected vice president in charge of operations of Youngstown Sheet and Tube Co., Youngstown, Ohio. Mr. Glossbrenner was born in Indianapolis, and for a time attended the University of Wisconsin. He entered the steel business as foreman with the American Sheet and Tin Plate Co. at Gary, Indiana, and later was transferred to the South Chicago steel plant of the Illinois Steel Co. Mr. Glossbrenner went with Youngstown Sheet and Tube Co. in 1935 as assistant superintendent of the hot strip mill at the Campbell works and a year later was made superintendent of that mill. In 1942 he was made superintendent of the Brier Hill works and ten months later became general superintendent of plants in the Youngstown district. On January 1, 1947 Mr. Glossbrenner was elected assistant vice president in charge of steel operations at all plants.

Mr. Glossbrenner is president of the Association of Iron and Steel Engineers for 1950.

Sigurd Landen was named chief engineer—construction engineering bureau for Carnegie-Illinois Steel Corp., Pittsburgh, Pa. In this newly created position, Mr. Landen will be in charge of the construction engineering bureau which is being established in the general offices, Pittsburgh, to execute major plant construction projects. Mr. Landen, a native of Sweden, is a graduate of the Chalmers Institute of Technology, Goteberg, Sweden. He joined Carnegie-Illinois in 1924 as a draftsman at the company's Gary steel works. After several promotions, he was made assistant chief engineer of the plant in 1945 and chief engineer in 1947. He was made district engineer, Chicago district, in 1948.

Herman P. Rassbach, former works manager of Midvale Co., has joined the Electro Metallurgical division of Union Carbide and Carbon Corp. as metallurgical engineer with the development group. He will make his headquarters in Chicago, Ill. Mr. Rassbach is a graduate of the Carnegie Institute of Technology and has had extensive experience in open-hearth and electric-melting practice, including the production of all grades of carbon steel, low-alloy and high-alloy steels, and armor plate. Prior to becoming works manager at Midvale, with which he has been associated for the past 24 years, he was superintendent of the melting and forge department.

David E. Davidson was elected vice-president for sales, Link-Belt Co., with headquarters at 307 N. Michigan Ave., Chicago, Ill. Mr. Davidson, a mechanical engineering graduate of Armour Institute of Technology, has been general manager at the company's Pershing Road plant, Chicago, since 1947. He entered the employ of the company's Caldwell plant, Chicago, in 1924 in the shop.

John M. Stevenson has joined Youngstown Sheet and Tube Co., Youngstown, Ohio, as a development engineer in its mill research and development department. For the present Mr. Stevenson will be locat-

FRANK PURNELL J. L. MAUTHE A. S. GLOSSBRENNER SIGURD LANDEN

in the company's Tulsa, Okla., office, but later will be located in Dallas, Tex. For the time being he will concern himself principally with pipe line problems.

J. A. Voss, director of industrial relations, Republic Steel Corp., Cleveland, Ohio, has resigned following an extended period of illness. Succeeding Mr. Voss, will be **E. J. Magee** who had been acting director for many months. Mr. Magee is a veteran of 27 years with Republic and its predecessor companies, most of which was spent in industrial relations work. **R. H. Ferguson** was named assistant director of industrial relations. Mr. Ferguson had been manager of safety since 1933. **Walter M. Nelson** succeeds Mr. Ferguson as head of Republic's safety program.

C. L. Warrender is now devoting a portion of his time as rolling mill consultant for some of the western steel mills. The balance of his time is spent representing a number of eastern rolling mill machinery builders. Recently, he was appointed representative for Voss Machinery Co. Before going to the West Coast, Mr. Warrender was connected with a number of the large steel companies as superintendent of plant and hot strip mills. From 1937 through 1940 he was manager of the hot rolling mills for Richard Thomas Co., Ltd., in Ebbw Vale, Great Britain.

K. A. Vaughan, manager, field engineering, for Gould Storage Battery Corp. was advanced to the newly created position of manager, sales engineering.

E. G. Schroeder was appointed to the position of sales manager of Electric Products Co. Previously associated with Electric Products as field sales manager, and prior to that position, district manager of their Detroit, Mich., office.

Edward G. Meyers, general superintendent of Timken Roller Bearing Co., Columbus, Ohio, was advanced to the new position of master mechanic. **Charles A. Russell,** assistant general superintendent, was named general superintendent. **Paul Shuler,** assistant director of labor relations was promoted to assistant general superintendent. **Edward F. Lannigan,** a trainee, has been made assistant director of labor relations.

John R. Hewitt was named general superintendent of blast furnace and heavy construction for Affiliated Furnace and Engineering, Inc., Pittsburgh, Pa.

Thomas J. Dempsey, Jr., was appointed to the sales force of the L. N. Crissman Co., Pittsburgh, Pa. Before joining Crissman, Mr. Dempsey was with the National Bearing division of the American Brake Shoe Co. as manager of the Pittsburgh sales office.

General Brehon Somervell, president of Koppers Co. Inc., since May, 1946, was named chairman of the company's board of directors. His election came at the annual meeting of the board, following the retirement of **J. P. Williams, Jr.,** as company chairman. Mr. Williams was elected to the presidency of Koppers Co. and as executive vice president of Koppers United Co. in 1939. From 1944 to April, 1946, when General Somervell became president, he served as president and chairman of the board of the present company. In May 1949, Mr. Williams announced his retirement from active management of the company, but had retained the chairmanship. He will remain a member of the board. **W. F. Munnikhuysen,** who has been vice president and general manager of the company's Wood Preserving division, was made executive vice president of the company.

J. W. Walling has been named assistant to the works manager for Kaiser Steel Corp., Fontana, Calif. **Barney N. Dagan,** open hearth superintendent assumes the responsibilities of division superintendent, iron and steel. Replacing Mr. Dagan as open hearth superintendent is **W. F. Bowers, Jr.,** who previously served as his assistant. **Mitchell A. Thompson,** until now general foreman of the open hearth, has been raised to the position of assistant superintendent. **Richard Aubrey,** formerly an assistant to the chief of operations at the Kaiser mill, has been appointed metallurgical engineer, tubular products.

Dr. James T. Eaton has been named director of research of E. F. Houghton & Co., Philadelphia, Pa.

E. J. MAGEE

R. H. FERGUSON

WALTER M. NELSON

Dr. Eaton, who was formerly titled manager of research, is in full charge of the company's research and control department.

Charles R. Elliott, Jr. was named eastern district sales manager for Duff-Norton Manufacturing Co. with headquarters in New York, N. Y.

P. B. Postlethwaite, president and chairman of the executive committee for Wagner Electric Corp., St. Louis, Mo., for the past 24 years, was elected chairman of the board. He will continue to serve as chairman of the executive committee. **J. H. Devor,** who has been vice president since 1941, was elected president. **H. N. Felton,** manager of the St. Louis sales branch, was named vice president in charge of sales. **L. W. McBride,** credit manager, was elected assistant secretary-treasurer.

James A. Whiting was appointed assistant superintendent of blast furnace department, Youngstown Sheet and Tube Co., Campbell, Ohio. Mr. Whiting was formerly assistant superintendent of blast furnaces at Hubbard, Ohio. He succeeds **John F. Agerter** who was transferred to Indiana Harbor, Ind., works as superintendent of blast furnaces.

A. G. Delany has been named assistant manager of Republic Steel Corp.'s southern district. Mr. Delany was formerly superintendent of maintenance for the southern district. **E. L. Brown,** general superintendent of Republic's steel plant at Gadsden, Ala., has resigned.

Carl M. Riefkin was appointed general manager of the rolling mill division, Newport Steel Corp., Newport, Ky. Mr. Riefkin has been associated with the steel operations at Newport for 26 years.

Walter T. Nicholson, superintendent of the wide flange structural department, South Chicago works of Carnegie-Illinois Steel Corp., has been appointed assistant to rolling division superintendent. **Patterson S. Weaver,** formerly assistant to general superintendent succeeds Mr. Nicholson. **J. R. Ferguson, Jr.,** works assistant chief engineer succeeds Mr. Weaver. **H. S. Spitz** succeeds Mr. Ferguson and was transferred to Chicago from Pittsburgh district where he held a similar post at Clairton, Pa., works.

Herman Dobscha is now manager of Wheeling Steel Corp.'s Smith works succeeding **John Tatman. W. G. Hobstetter,** chief engineer of the Smith works was transferred to the Yorkville works in the same position.

Lewis M. Parsons, formerly assistant to vice president-sales, has been elected a vice president, director, and member of the executive committee of United States Steel Corporation of Delaware.

C. Porter Packard was named sales manager of the Crocker-Wheeler division, Elliott Co. located at Ampere, N. J.

Walther H. Feldmann who has resigned as president of the Worthington Pump and Machinery Corp.'s subsidiary Electric Machinery Mfg. Co. of Minneapolis, Minn., has been named vice president in charge of sales for Worthington.

E. T. Peterson was named vice president, engineering for Birdsboro Steel Foundry and Machine Co., Birdsboro, Pa. Mr. Peterson has been associated with

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USED BY LEADERS

Here is a partial list of users of the Lintern Aire-Rectifier. Several have up to twenty Aire-Rectifiers in a single plant. We value highly the confidence thus expressed in our product.

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Aluminum Company of America
Tennessee, Texas, and Davenport, Iowa, Plants
American Steel & Wire Company
Andrews Steel Corporation
Atlantic Steel Company
Atlas Steels, Limited
Bethlehem Steel Corporation
Bethlehem, Lackawanna, Steelton, and Sparrows Point
Birmingham Slag Company
Canadian Carborundum Company
Carnegie-Illinois Steel Corporation
Gary, South, and MacDonald Works
Colorado Fuel and Iron Company
Columbia Steel Corporation
Electro-Metallurgical Company
Ford Motor Company
Detroit and Canadian Plants
Geneva Steel Corporation
Great Lakes Steel Corporation
Inland Steel Company
Jones and Laughlin Steel Corporation
Kennecott Copper Company
Keystone Steel and Wire Company
Laclede Steel Company
McClouth Steel Corporation
National Tube Company
Lorain and McKeesport Works
Northwestern Steel and Wire Company
Pittsburgh Metallurgical Company
Reynolds Alloy Corporation
Republic Steel Corporation
Cleveland
Rotary Steel Company
Southern Acid and Sulphur Company
Stanley Works, American Tube and Stamping Plant
Timken Roller Bearing Company
U. S. Navy
Weirton Steel Company
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Wheeling Steel Company
Wisconsin Steel Company
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MORGANITE engineering service — backed by years of specialized experience in motor and generator brush manufacture and application — assures competent, practical collaboration in solving any brush problem. For prompt help in the selection of the proper brush for your needs, or for quotations on brushes to your specifications, call or write MORGANITE
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Manufacturers of Morganite Self-Lubricating Carbon Specialties including Seals, Rings, Valves, Slides, Bearings, etc., and Carbon Piles

the company for 27 years, recently as chief engineer in the rolling mill department.

Gordon W. First, for many years district manager of Clark Controller Co., Pittsburgh, Pa., and New

GORDON W. FIRST

York, N. Y., offices, moved to St. Louis, Mo., to become district manager of that area.

Frederick H. Neuhardt, for several years working

FREDERICK H. NEUHARDT

out of the Clark Controller Co. New York office, succeeds Gordon W. First as district manager.

Arlo Israelson was named chief engineer of Eriez Manufacturing Co., Erie, Pa. Mr. Israelson comes to Eriez from the Flynn Machine Co., Inc., San Jose, Calif. He has also been associated with Koppers Co.

Arthur H. Nolde has been appointed operating superintendent of Falk Corp. machine shops, Milwaukee, Wisc. In his new position, effective April 17, he serves as assistant to Ben C. Bugbee, machine shop superintendent.

Robert H. Schleuning, was named sales representative for switching locomotives and other products of Plymouth Locomotive Works division, Fate-Root-Heath Co. in Western Pennsylvania and New York, Northern West Virginia and parts of Ohio and Maryland. Mr. Schleuning was formerly affiliated with Pressed Steel Car Co., Inc. for approximately sixteen years.

King H. McLaurin, formerly general superintendent, Carnegie-Illinois Steel Corp., Duquesne, Pa., was appointed special representative in the operating department of Carnegie-Illinois in the general offices at Pittsburgh, Pa. Mr. McLaurin began with

KING H. McLAURIN

U. S. Steel as a machinist at Duquesne works in 1912. One year later, he was named chief engineer of the blast furnace department. After service in World War I, he returned to Duquesne as assistant general master mechanic. He was appointed general superintendent of the plant in 1936, after serving four

Robert W. Graham was named general superintendent of Duquesne, Pa., works of Carnegie-Illinois Steel Corp. Mr. Graham has been assistant general superintendent of Homestead district works of Carnegie-Illinois for the past two years. A graduate of Carnegie Institute of Technology in metallurgical and

ROBERT W. GRAHAM

mechanical engineering, he was first employed at Homestead as a transfer operator in the 42-in. mill in 1925. He was appointed superintendent of the 100-in. mill there in 1936 and became division superintendent of the plate and slab department in 1940. In 1943, Mr. Graham was transferred to Geneva Steel Co., Provo, Utah, as division superintendent in charge of rolling mills. He returned to Homestead in 1947 as assistant to the general superintendent.

BROWNING
MILL TYPE CRANES have
Plenty of Strength WHERE
STRENGTH IS NEEDED!

Browning Mill Type Cranes are built in accordance with A. I. S. E. specifications. They incorporate the types of motors and controls on which your mill or industry has standardized. This flexibility adapts your VRB crane *perfectly* to your needs. Only the finest materials are employed. Browning heavy duty cranes meet the most rigid demands and satisfy the most critical users. Our design, placing plenty of strength wherever needed, is the outgrowth of 48 years' experience in the crane industry.

Write for our Bulletin "S".

"Built as you yourself would build them"

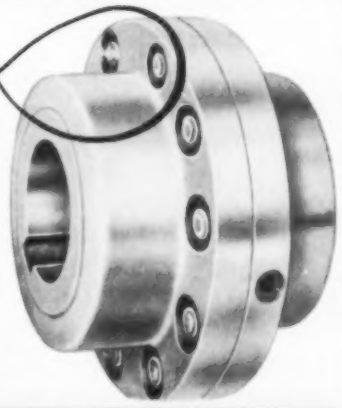
VICTOR R. BROWNING & COMPANY, Inc.
BOX 309, WILLOUGHBY (CLEVELAND), OHIO
Designers and Builders of Electric Overhead Traveling Cranes and Hoists and Electric Revolving Cranes

BETTER BUILT *means*
BETTER SERVICE *with*
WALDRON *advanced Gear Type* COUPLINGS

For example, Waldron Couplings are made with

One-Piece Cover Sleeve

No Welded Sections here



The Waldron cover sleeve is one solid forged steel piece with no welding to distort the accurate gear inside. This feature not only prevents possible trouble but also permits operation at highest speeds.

For details on other construction and operating advantages—ratings, service factors, etc.—ask for Catalog 57.

JOHN WALDRON CORP.
Main Office and Works
New Brunswick, New Jersey
COUPLINGS

Sales Representatives in Principal Cities.

Edwin L. Tindall was named chief engineer-operations for Carnegie-Illinois Steel Corp., Pittsburgh, Pa. In the newly created position, Mr. Tindall will assume all of the responsibilities heretofore performed by Sigurd Landen as district engineer, Chicago, Ill., as well as his own duties as district engineer, Pittsburgh,

EDWIN L. TINDALL

Pa. Mr. Tindall, a mechanical engineering graduate of the University of Illinois, joined Carnegie-Illinois as a combustion engineer at the company's South Works in Chicago in 1935. He came to the engineering division in Pittsburgh in 1940 as a power, fuel and steam engineer. He was made chief engineer of the company's Edgar Thomson works in 1947, and was made district engineer for the Pittsburgh district in 1948.

Leonard P. Schaefer was appointed corrosion engineer for the Hinchman Corp., Detroit, Mich.

William C. Bennett replaces Charles J. Fleisch as division superintendent of Carnegie-Illinois Steel Corp.'s Homestead blast furnaces located at Rankin, Pa. He joined Carnegie-Illinois as an observer in the metallurgical department at Homestead in 1937 and has held various positions at Carrie Furnaces since 1939. He has been assistant superintendent of the division for the past four years.

Douglas M. Considine has been appointed manager of the market extension division, general sales, of the Industrial division of the Minneapolis-Honeywell Regulator Co. Mr. Considine's new duties will include direction of advertising and technical and trade editorial activities.

Anthony J. Potts has been appointed Chicago, Ill., district manager of Selas Corp. of America. Before his appointment as Chicago manager, Mr. Potts was in the Selas main office and plant in Philadelphia. Prior to joining the Selas staff, Mr. Potts represented George J. Meyer Manufacturing Company. Earlier, he was with the Industrial division, Minneapolis-Honeywell Regulator Co.

Lawrence J. Kline was appointed sales manager of the Automatic division of Automatic Transportation Co., Chicago, Ill. Mr. Kline comes to Automatic from the Mercury Manufacturing Co. He left, after 30 years service, with the title of executive vice-president. In 1928 he became general manager, and reached his final post in 1947.

Howard M. Graff was appointed to the position of assistant general superintendent of Inland Steel Co.'s iron ore mines, Ishpeming, Mich.

Robert C. Bennett, Jr. is the new vice president and sales manager of National Electric Products Corp., Pittsburgh, Pa.

J. S. Robbins has been named sales engineer for Vulcan Mold & Iron Co., Latrobe, Pa. Mr. Robbins comes to Vulcan from the Canton, Ohio, plant of Republic Steel Corp., where he had been employed for the past 15 years in the melting department.

Charles J. Fleisch was appointed assistant general superintendent of Homestead district works, Carnegie-Illinois Steel Corp. He succeeds **Robert W. Graham,** who has been appointed general superintendent of the company's Duquesne works. Mr. Fleisch was graduated from Carnegie Institute of Technology with a degree in mechanical engineering. He started with U. S. Steel as a rodman in the civil engineering department at Homestead in 1919. He was named assistant to the general superintendent at Homestead in 1944, and the following year was appointed division superintendent at Carrie Furnaces.

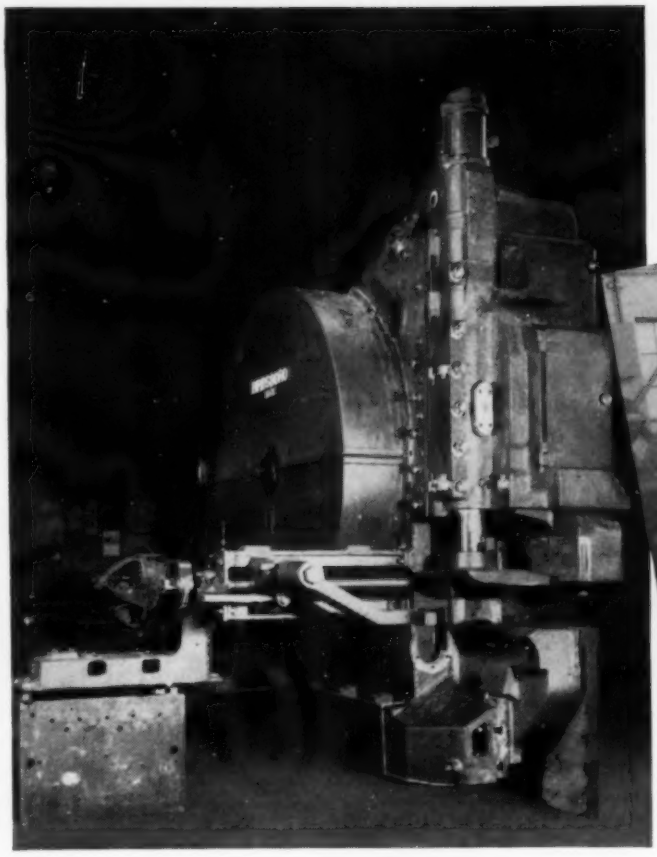
E. H. McNeill, formerly assistant manager of the Chicago district has been appointed Manager of Utility and Industrial Sales for Okonite Co.'s entire Middle-West territory, which extends from the Indiana-Ohio line to the Rocky Mountains.

James L. Snaman was appointed general sales manager for Pannier Corp., Pittsburgh, Pa.

Cecil H. Gay, works manager of the Barberton, Ohio, plant of Babcock & Wilcox Co., was elected vice president. Mr. Gay, who joined the company after graduation from the University of Nevada in 1928, has been connected with the Barberton operations since 1932. As a special assignments engineer for the company he had an important part in designing and building the world's largest penstocks for Hoover Dam, and for Gauley Bridge in West Virginia. In 1939 he was promoted to assistant superintendent of Barberton works. During the war Mr. Gay was especially instrumental in setting up the war work which B & W did in its plant in Alliance, Ohio, where special work was done in the production of gun mounts and other war material. He became superintendent of the Barberton works in 1947 and manager of both Barberton and Alliance plants in 1948.

J. J. Sullivan was named superintendent of Republic Steel Corp.'s 98-in. hot strip mill at Cleveland, Ohio. Mr. Sullivan succeeds **W. M. Ramsay** who has resigned. Mr. Sullivan has been with Republic since the erection of the 98-inch strip mill in 1937 starting as a rougher on the hot mill. Prior to his association with Republic, Mr. Sullivan was employed by Youngstown Sheet and Tube Co. and the A. M. Byers Co. at Girard, Ohio, and Ambridge, Pa., respectively.

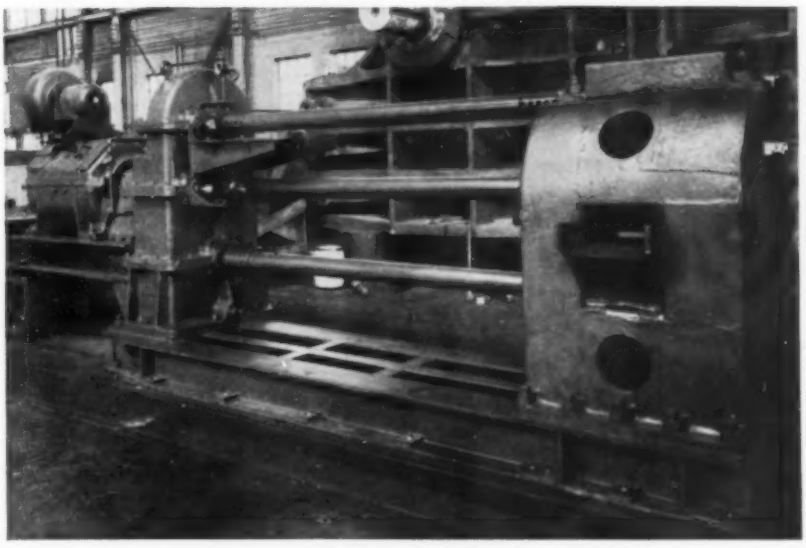
Loyal R. Milburn, formerly of Great Lakes Steel Corp., has returned from Korea where he was chief of the U. S. power mission to Korea. Mr. Milburn is resuming his consulting engineering practice.



770 Ton Up & Down Cut Shear and Gauge

1″x100″ Up & Down Cut Shear

Merchant Mill Flying Shear



You can depend on

Birdsboro's long and specialized experience not only for the building of all types of stationary and flying shears but for the modernization of existing units to raise them to highest operating efficiency.

BIRDSBORO STEEL FOUNDRY & MACHINE CO. • BIRDSBORO, PENNSYLVANIA

Offices in:
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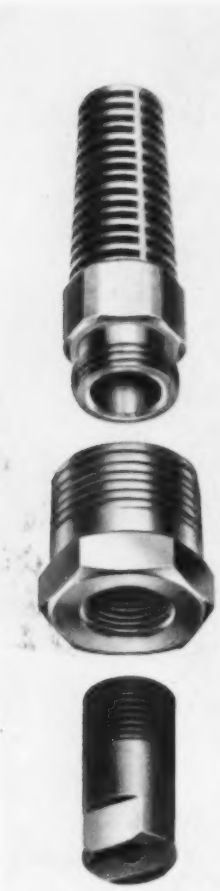
MM 6-50

BIRDSBORO
STEEL MILL MACHINERY

Designers & Builders of: Steel Mill Machinery • Hydraulic Presses • Rolls • Special Machinery • Steel Castings • Crushing Machinery

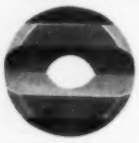


UNIFORM descaling

with the Spraying Systems Descaling Nozzle

This hardened stainless steel nozzle provides a constantly uniform flat spray for clean descaling operations . . . all streaking is eliminated. Available in wide range of capacities.

LARGE DIAMETER ORIFICE

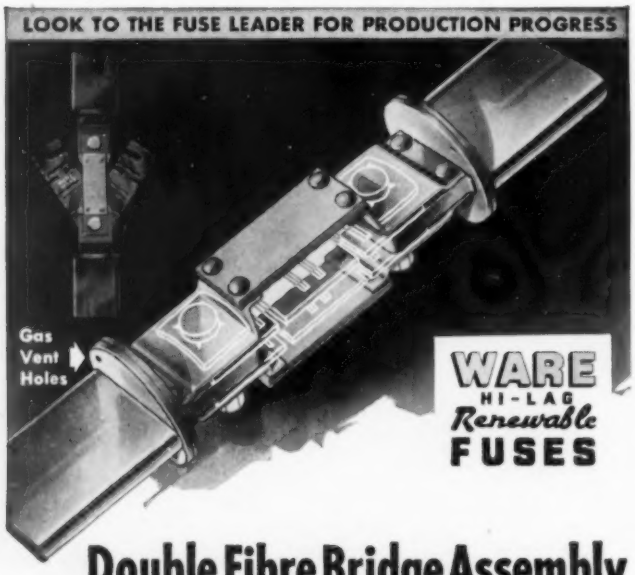


Note that the orifice is almost circular in shape . . . far less tendency to clog than the "old style" slotted orifice. Initial cost is lower. Maintenance cost is lower.

Write for complete information on this quality built nozzle and its large capacity strainer and adapter. Ask for Catalog 22 and Data Sheet 3997.

SPRAYING SYSTEMS CO.
3262 RANDOLPH STREET
BELLWOOD, ILLINOIS
(Suburb of Chicago)

LOOK TO THE FUSE LEADER FOR PRODUCTION PROGRESS



Double Fibre Bridge Assembly
Increases Strength 10 Times

WARE HI-LAG Fuses have the strongest, most rigid knife blade assembly ever designed in fuses. The two heavy fibre bridges are supported by sturdy brass brackets which add greatly to the strength of the assembly. These bridge supporting brackets are attached to the copper knife blades and contact the entire end of links so that current flows through the brackets as well as the blades over a large area. Another reason for WARE HI-LAG Fuse's cool operation.

Approved by Underwriters Laboratories

Write for descriptive Circular

WARE FUSE CORPORATION
4460 W. LAKE ST. CHICAGO 24, ILL.

Paul E. Thomas was made assistant general superintendent in charge of service department of Gary,

PAUL E. THOMAS

Ind., Works, of Carnegie-Illinois Steel Corp. Since July, 1949 he has been assistant to the general superintendent.

OBITUARY

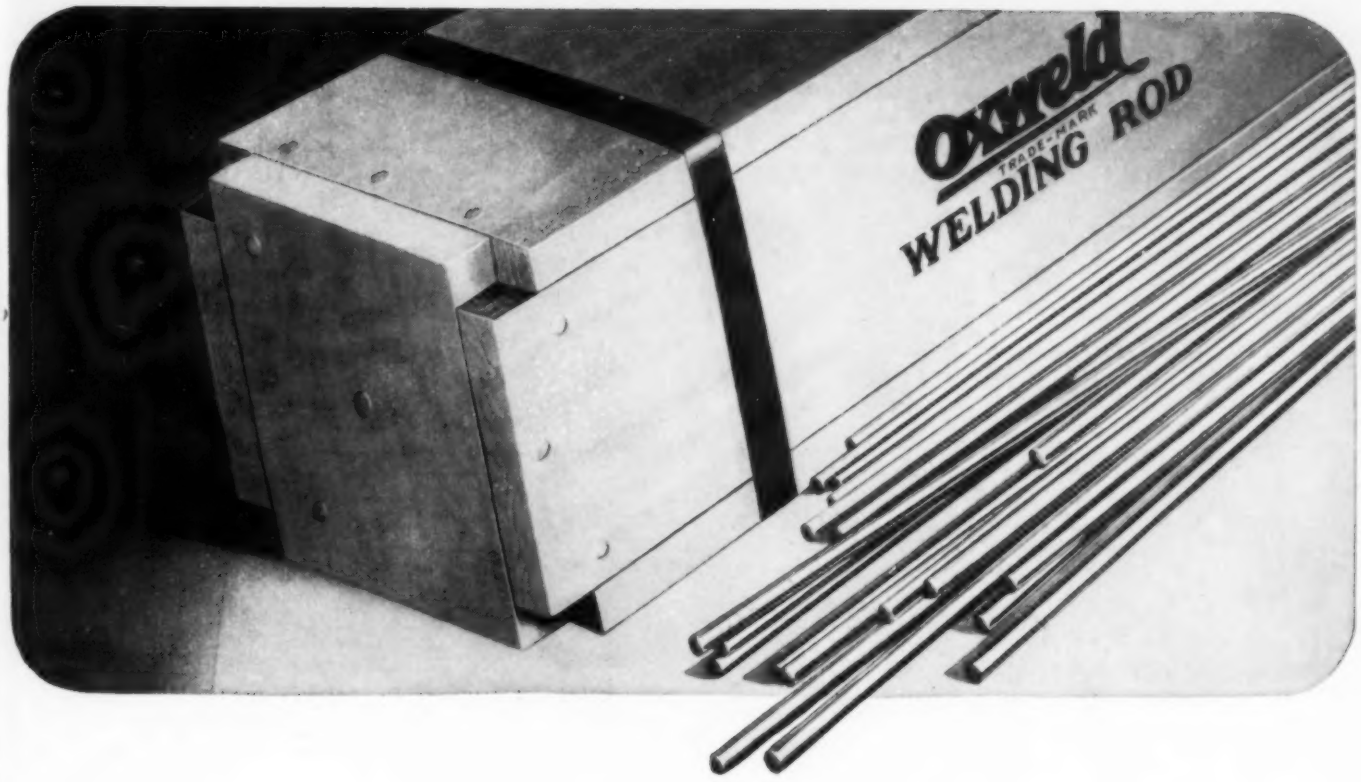
William H. Warren, general manager, Wheeling Steel Corp., Steubenville, Ohio, died April 3, 1950.

Leslie M. Gumm, 55, formerly manager of metal working sales for Westinghouse Electric Corp., East Pittsburgh, Pa. died April 19 at Shadyside Hospital, Pittsburgh, Pa. Mr. Gumm was a graduate of the University of Illinois. He went to the Pittsburgh headquarters from Chicago ten years ago. Prior to that he had been manager of steel mill and metal working sales from 1929 to 1938 for Westinghouse.

L. D. Holland, 46, assistant to the president and a member of the Board of Directors of E. F. Houghton & Co., Philadelphia, Pa., died April 14 after a long illness. He was connected with Houghton since 1927 as sales representative, western division sales manager, manager of research sales and assistant general sales manager.

Wilbur F. Pray, 50, New York district sales manager, Askania Regulator Co., died in Boston, Mass., on April 16. He had been active in the field of instrumentation and control since his graduation from the University of Maine in 1922. Since 1933 he had been associated with Askania, in the Chicago office and in recent years as New York district sales manager.

James M. Barton, formerly chairman of the board of directors and president of the Fretz-Moon Tube Company, Inc., died on April 14. Born in Mt. Gilead, Ohio, he had been associated with the National Tube Co. for 28 years before becoming president of Fretz-Moon in 1929. He was named board chairman upon the death of John Moon in 1942 and continued in that capacity until he retired in April of 1948 even though he had retired as president in 1945.



How "OXWELD" Trade-Mark Rods Reduce Welding Costs

☑ **You use less rod per weld,** because OXWELD Rods produce high-strength welds with minimum reinforcement. OXWELD No. 1 H. T. Rod, for example, has a tensile strength 11,000 lb. per sq. in. higher than any ordinary steel rod—enough *extra strength* to permit reduction of the amount of weld metal on a job, with substantial saving of gases and labor.

☑ **You weld easier and faster**—saving both time and gases—because all formulas for OXWELD Rods are worked out to give highest weldability as well as best possible physical properties in finished welds.

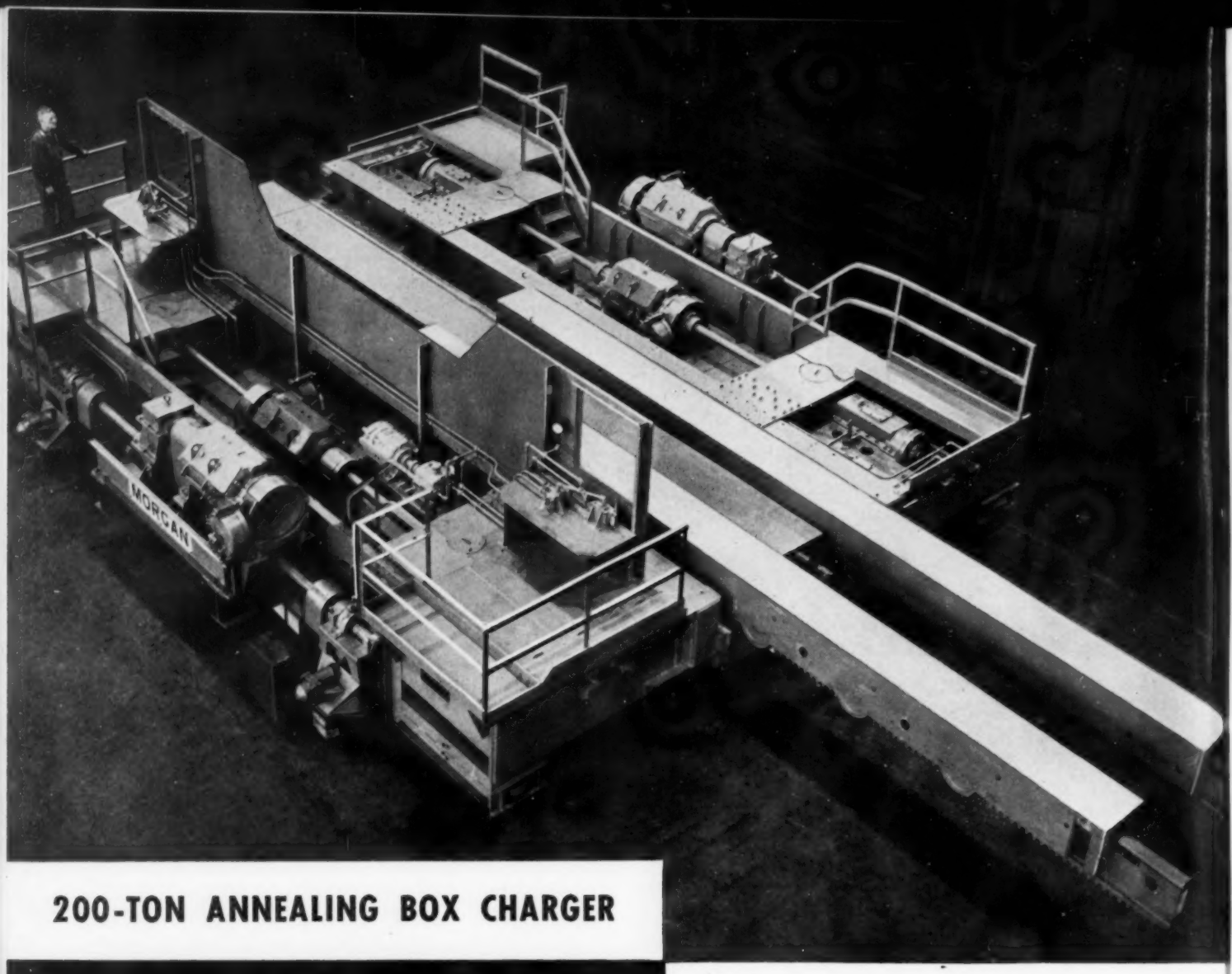
☑ **You get better welds at lower finishing costs,** because welds made with OXWELD Rods are always of uniform high quality, strength, and ductility—easy to machine and finish without excessive labor.

☑ **You need fewer types of rods** to handle your complete range of welding. Five OXWELD Rods—No. 1 H. T. Steel, No. 7 Drawn Iron, No. 25M Bronze, No. 23 Aluminum, and No. 9 Cast Iron—are sufficient for all average fusion welding, braze-welding, and bronze-surfacing. For the less frequent jobs of specialized nature, there are 9 additional welding rods and 8 hard-facing rods—all available from the same source.

The term "Oxweld" is a registered trade-mark of Union Carbide and Carbon Corporation.

Look for the **Oxweld** Trade-Mark on the rod or on the box

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N.Y.
Offices in Other Principal Cities
In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto



200-TON ANNEALING BOX CHARGER

BUILT BY MORGAN Engineering

Illustrated is a Morgan 200-Ton, 5-motor, 19′-3½″ Span Annealing Box Charger. It consists of a traveling bridge upon which are mounted two rack driven charging trucks operating in unison for raising the annealing boxes and moving them into or out of the furnace or onto the cooling beds. The charging trucks are operated by two motors through four worm units with provision for operating either of the two motors alone.

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO PITTSBURGH—1420 OLIVER BUILDING

DESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

Equipment News...

INGENIOUS APPLICATION OF MINERAL WOOL CONTROLS HEAT LOSS IN STEAM LINES

▲ A single ingenious application of mineral wool insulation at a Niagara Falls chemical plant is serving simultaneously to guard against freezing and prevent overheating in process lines, and to control heat loss in a steam line.

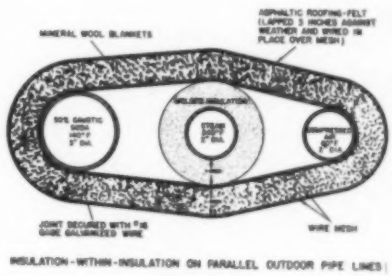
Generally when the contents of an outdoor process line must be kept from freezing, a steam line is run parallel to it, and the two lines are insulated within one insulation covering. The steam line heats the process line, the insulation provides protection from extreme temperature variations due to weather, and freezing during the winter is eliminated.

However, when the Stauffer Chemical Co., Niagara Falls, N. Y., planned to apply this technique and make use of a 340 F steam line carrying steam to interplant processes, it was found that the steam line would overheat the process lines. (In this case there were two process lines—a caustic soda line and a compressed air line.)

The common-sense solution was to insulate the steam line to a thickness which would permit escape of only enough heat to prevent freezing of the caustic soda and the moisture in the compressed air. This was done, with the result that, when the pipe-trio was encased in an overall covering of mineral wool, the process lines were prevented both from freezing and overheating. Further, the steam line was sufficiently insulated by the double layer to prevent heat from wasting to the atmosphere. Overheating of the process lines during the summer was also prevented by this insulation-within-insulation technique.

The insulation technique used in this type of application is indicated in the cross-sectional drawing. First, after removing extraneous material such as grease and dust from the 300 ft pipes, 1-inch molded sectional pipe insulation is applied over the entire surface of the 2-in. steam pipe with the sections tightly butted together and securely held in place by metal bands.

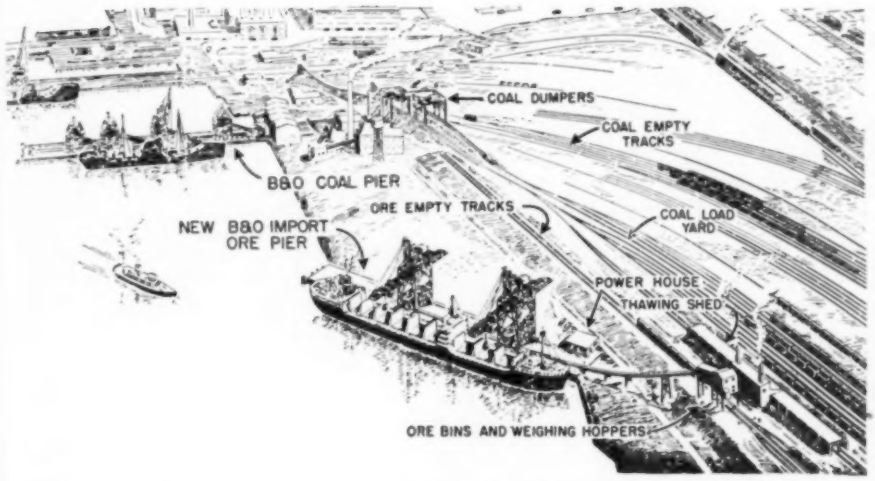
Second, mineral wool blankets, sandwiched between facings of wire mesh, are cut and shaped around the three pipe lines. The blankets are then wired in place with 16-gauge galvanized wire. Abutting ends and edges of the blankets are tightly laced together with 16-gauge galvanized wire woven into the mesh coverings. To complete the outdoor installation, asphaltic roofing-felt is wrapped around the entire surface, lapped three inches against the weather and bound on approximately 6-in. centers by galvanized wires wrapped around the felt and tightly secured.



The blankets of mineral wool are wired in place with 16-gauge galvanized wire.

Engineered insulation techniques such as this one can be profitably applied to outdoor piping systems in chemical, petroleum and manufacturing industries where continuous operation must be maintained under all weather conditions. Freezing of process materials resulting in costly interruptions in production and often permanent damage to vital equipment is eliminated by simple, well-planned insulation methods such as that applied by the Stauffer Chemical Co.

BALTIMORE TO GET IMPORT ORE PIER



Engineers have completed the design of the new B & O import ore pier at Baltimore, Md., as shown in the above drawing. The pier, designed for the handling of imported ores from Liberia, Venezuela, Chile and other foreign countries, will cost $5,000,000. It will be completed early in 1951. Awards of contracts for pier construction, for dredging and for the manufacture of the ore handling machinery were recently announced by the B & O. Incoming coal-laden hopper cars, emptied at the adjacent coal pier, can be switched quickly to the ore pier for reloading and outbound movement.

PORTABLE HAND TORCH LIGHTS WITH MATCH

▲ A versatile new portable hand torch that can be instantly lighted for any maintenance job requiring the application of heat or a hot flame has been perfected after extensive field tests with maintenance men and is now in the hands of jobbers.

It is the "Prepo" hand torch, which lights instantly with a match, burns with a clean, blue, hot flame and does away with all pouring, pump-

ing and priming characteristic of ordinary blow torches. "Prepo" fuel is supplied in a disposable can, much the same size as an ordinary beer can, which is sealed and locked in place as a part of the torch. When empty, the container is removed, thrown away and a new, full can of fuel attached.

The new fuel is a compound of hydrocarbons which is self-pressurizing and self-vaporizing. It is a non-toxic, non-poisonous low pressure fuel. Packed in the new, handy container, it seals into the torch in such a way that when the valve is opened the burning tip can be lighted with a match as easily as lighting a gas stove. Within 30 to 60 seconds the flame achieves its maximum heat of more than 2200 degrees.

Field tests have shown that the new torch is ideal for hundreds of jobs done daily around maintenance shops. Both torches and fuel are being marketed nationally by three leading companies. They are Maremont Automotive Products, Inc., Appleton Electric Co. and Bell & Gossett Co.

DUAL FUEL BURNER LINE IS AUGMENTED

▲ Two new sizes have been added to the recently announced line of North American "Series 225" dual fuel burners and various improvements in design have been made. These are the combination gas-oil burners which were especially designed for such rugged applications as forging, heat treating, smelting, kiln and drier firing with light or heavy oils and low pressure air as well as gas of any Btu content.

These burners, manufactured by North American Manufacturing Co., are now available in 1¼ in., 2 in. and 3 in. sizes. Of major importance in improvements is the new refractory tile which has been redesigned to give greater stability to the flame without the danger of carbon formations. The tile is shipped from the factory cemented and bolted to the tile mounting plate rather than separately as was done before. This not only simplifies installation of the tile to the furnace but also prevents the tile from separating from its mounting during operation causing unwanted air to leak in around the setting.

These burners are available in 1¼ in. 2 in., and 3 in. sizes.

INDUSTRIAL GREASE HAS HIGH MELTING POINT

▲ A new multi-purpose industrial grease called "Alvania" is now available in larger quantities. The new grease has been in great demand among industrial and processing plants that require a single product combining all the advantages of many special-purpose greases.

Manufactured exclusively under a Shell Oil Co. patent, the new product is called the "Million Stroke" grease because of its ability to resist structural breakdown. It has a high melting point, provides great resistance to both heat and water and, therefore, can be used to replace sodium, calcium, aluminum and mixed-base greases. The new grease is pumpable at low temperatures, even in unheated storage, yet it maintains its consistency almost indefinitely and keeps leakage down to a minimum. It also possesses great oxidation stability (resists hardening and drying), prevents excessive wear and is nontoxic.

PUMP CONTROLS WATER FOR MASONRY SAW

▲ A new factory-sealed water pump installed on the "Model HD" Clipper masonry saw eliminates the necessity of disconnecting the pump when cutting dry.

To switch from wet to dry cutting the operator merely turns the pet cock on the outlet of the pump. This new pump cannot be damaged by dry cutting, there is no need ever to remove the V-Belts.

On pumps that can be burned out when run dry, there is constant danger of forgetting to disconnect the V-Belt, letting the water in the reservoir run low or clogging the water suction line with severe damage resulting to the pump. The new factory-sealed pump eliminates all such worry—its operation is foolproof. No maintenance is necessary as a factory-exchange plan is set up to handle any difficulty.

The water application system, adds to the high efficiency of the new pump in the scientific control of the water flow to the cut. All portions of the blade and cut are adequately bathed to guarantee smooth, cool cutting and longer blade life. This is particularly valuable when using diamond blades where exactingly controlled water flow is vitally important.

The new "Model HD" saw is the only one of the nine models to feature the factory-sealed pump and the water application system.

PEERLESS LABORATORY GETS GE EQUIPMENT

▲ Electric equipment recently installed at the Indianapolis, Ind. plant of the Peerless Pump division, Food Machinery Co., has given that company what is believed to be the most up-to-date pump laboratory in the world. Supplied by General Electric, the equipment in general consists of dynamometers, adjustable voltage power supply, and control.

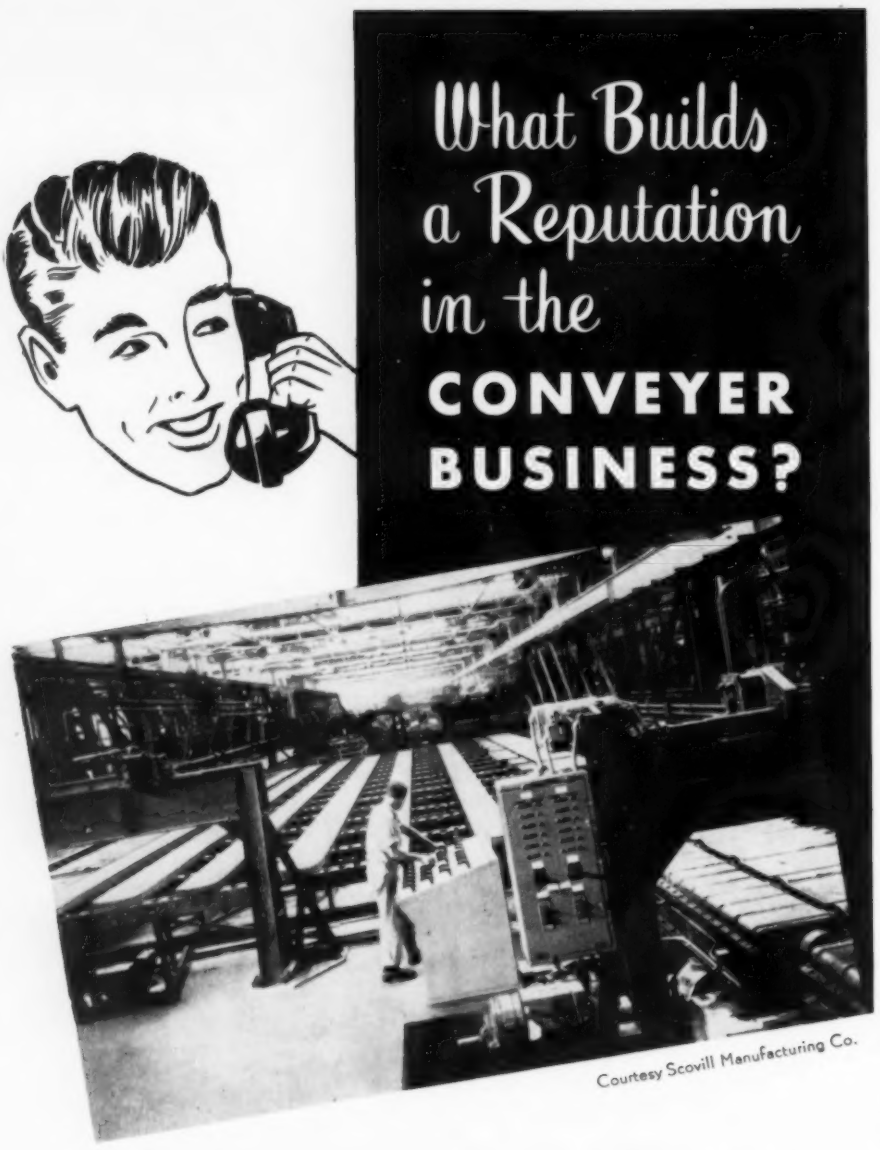
Engineers at Peerless will use the apparatus in extensive testing of centrifugal pumps at the laboratory to further the company's manufacturing and development program. The laboratory contains provision for 12 pump-testing stations, and at the present time dynamometer equipment has been set up for seven test stands. The tests performed at these stands correlate pump capacity with electric load characteristics, it was said, to assure close adherence to specifications and high efficiency operation of the pumps which are manufactured by Peerless.

The GE equipment enables Peerless technicians to determine accurately the characteristics of pumps ranging from 10 to 450 hp and from approximately 250 to 4500 rpm. Electronic pre-amplifiers in the system in conjunction with amplidynes provide precision speed control—within plus or minus 0.5 per cent,

...always a fast, even heat
...like INTERNATIONAL GRAPHITE ELECTRODES

International GRAPHITE AND ELECTRODE CORP.
ST. MARYS, PA.

6261



It's experience that builds a reputation in the conveyer business—and only years of dealing with thousands of conveying problems can provide it. The lessons learned along the way—the good jobs—the difficult ones—those that weren't so good—the equipment that was too light, or heavier than it needed to be—all go to make up a seasoned, well-balanced materials handling organization—people that can give a dependable conveyer service to both light and heavy industry.

Mathews Engineers have been dealing with conveying problems for nearly 50 years. They have the stuff of which reputations are made—good, solid experience. There is no substitute for it.

The benefit of this experience, and the facilities of three modern plants are available to American and Canadian Industry. Your handling problem is our business. Your Mathews Engineer would like to tell you about Mathews Conveyer Systems, and the smooth, continuous flow of materials which they create.

MATHEWS CONVEYERS

GENERAL OFFICES . . . . . *Mathews Conveyer Company*
ELLWOOD CITY, PENNSYLVANIA

PACIFIC COAST DIVISION . . *Mathews Conveyer Company West Coast*
SAN CARLOS, CALIFORNIA

CANADIAN DIVISION . . . . . *Mathews Conveyer Company, Ltd.*
PORT HOPE, ONTARIO

Engineering Offices or Sales Agencies in Principal American and Canadian Cities

according to engineers who worked on the project.

Four d-c dynamometers, rated 10 hp, 75 hp, 200 hp, and 450 hp, comprise the bulk of the GE apparatus at the installation. All are 250-volt units equipped with blowers, tachometer generators, and chronotachometers. The three smaller machines are ball bearing cradled and are rated at 1500/4500 rpm. The 450-hp dynamometer is sleeve bearing cradled, rated at 1100/3600 rpm. both the 200-hp and the 450-hp units feature motor-driven oil pumps.

Other equipments furnished by GE include two 200-kw synchronous motor-generator sets, a 30-kw induction motor-generator set, amplidyne sets, motor starters, electronic controllers, master control panels, and stainless steel master control desks.

WEIRTON SPEEDS UP 15-YEAR OLD STRIP MILL

▲ Westinghouse Electric Corp. recently received an order from the Weirton Steel Co. for $840,000 worth of electrical equipment for modernization of a 15-year-old strip mill. The modernized mill will be driven by new electric motors totalling 10,100-hp—an increase of 6000-hp; and the speed of the mill will be doubled—from 1500 to 3000 ft per minute.

K. M. Patterson, manager of the steel-mill section for the Westinghouse industrial sales department, said the equipment included new electric motors and controls for a 36-in. 4-stand tandem cold-reduction strip mill at the steel company's plant in Weirton, W. Va. In addition to the four motors to power the mill stands and one for the reel, totalling 10,100-hp, Westinghouse also will supply a synchronous motor-generator set. With an 8,000-hp driving motor, this set will operate together with an existing motor-generator set to furnish power to drive the mill, motors and to control their speed.

The revamped mill will produce the full range of low-carbon strip from 18 to 24 in. wide, with finishing thicknesses from 0.007-inch to 0.05-in. The lighter gages will be rolled at a maximum speed of 3000 fpm, and the heavier gages at progressively lower speeds.

PARALLOY

REGISTERED TRADE MARK

A name of Quality in

PINCH ROLLS
COILER ROLLS
TENSION ROLLS
STEEL MILL ROLLS

NO SCRATCHING OR GALLING

500-600-BRINNELL

MORE TONS PER PASS

OTHER PRODUCTS

HYDRAULIC SLAB AND BILLET PILERS
STRIP AND SHEET OILING EQUIPMENT
SHEET SCRUBBER AND CLEANING LINES
HOT SAWS—ROCKING AND SLIDE TYPES
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BILLET EJECTORS—PINCH ROLL STANDS
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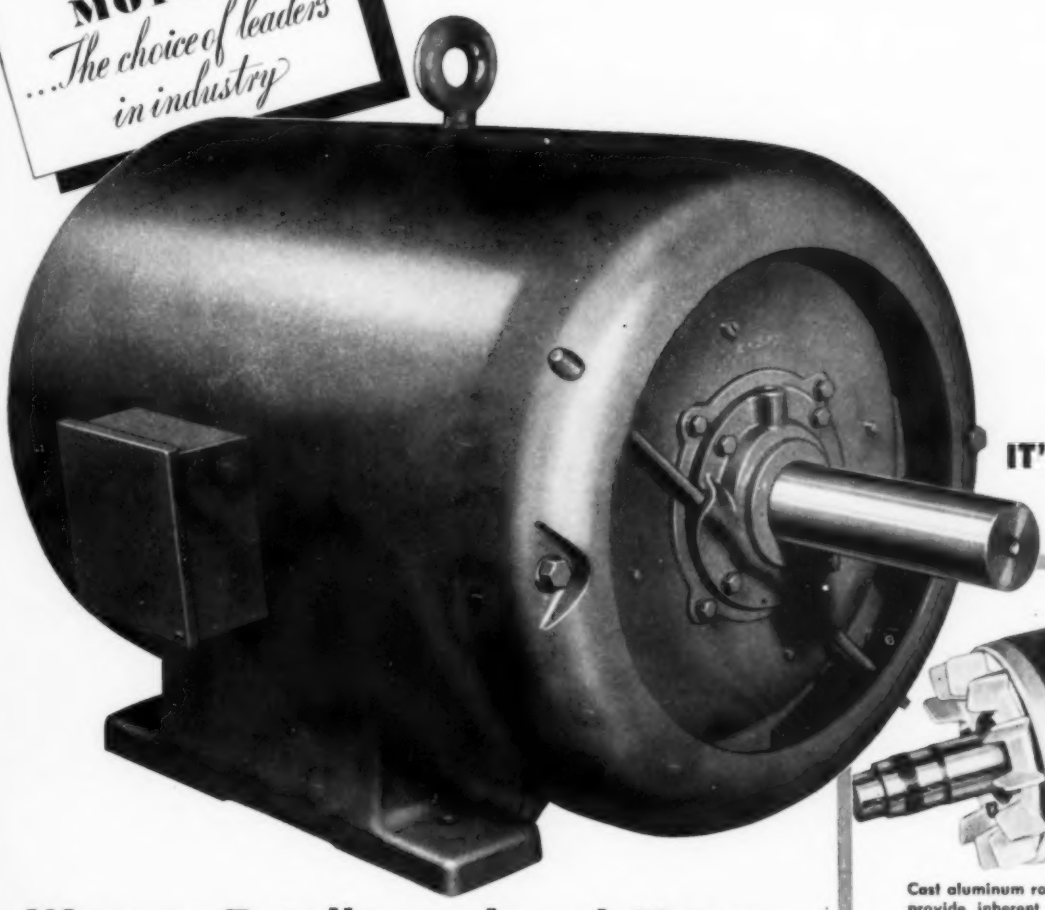

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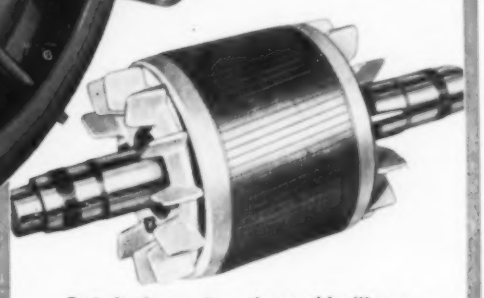

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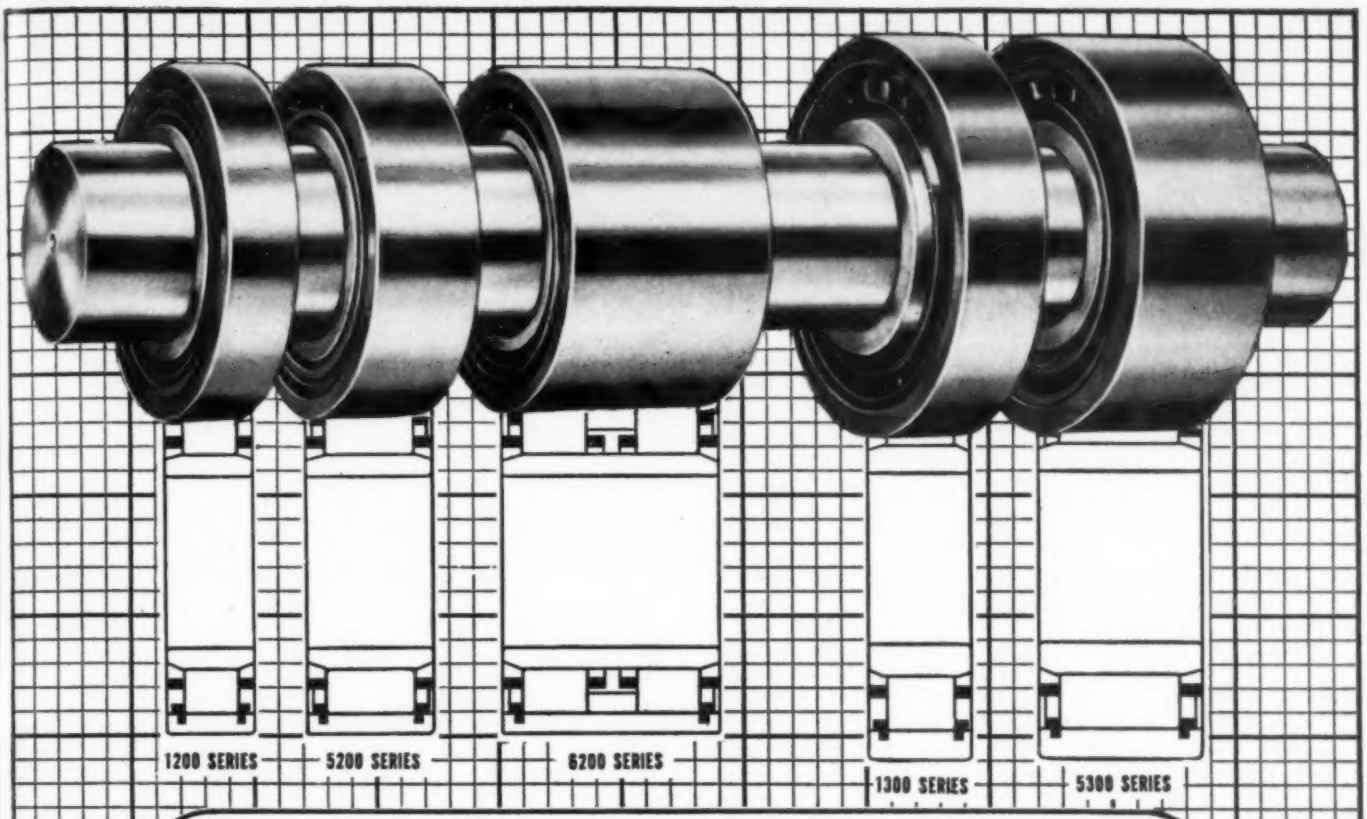

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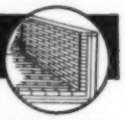

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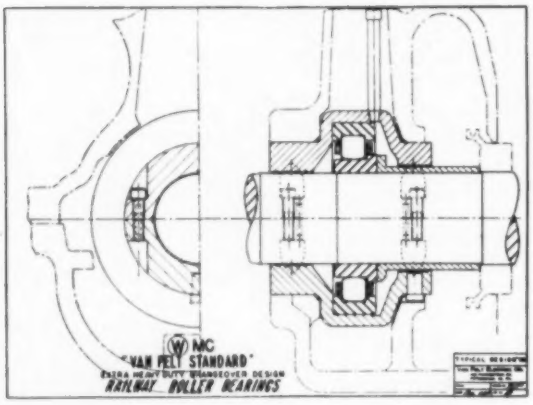
CHANGEOVERS

★ For Westinghouse Type MC Mill Motor Bearing Changeovers



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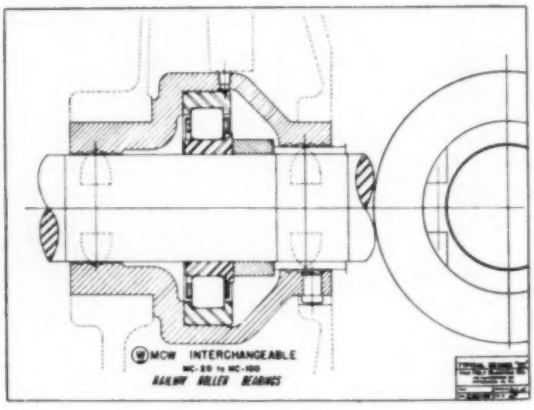
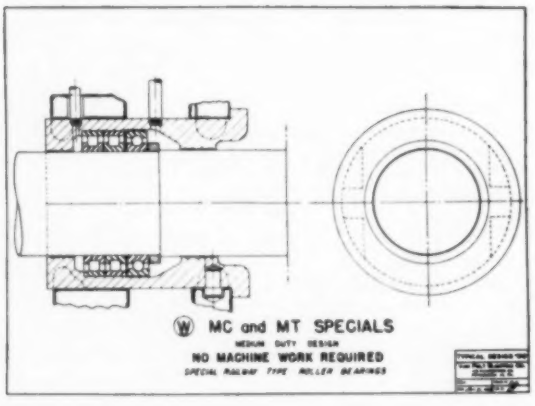
This design, the very best possible, permits full interchangeability with the old sleeve bearing armature in the frame adapted for the Roller Bearing Cartridge. It provides extreme life for least cost.



INTERCHANGEABLE HEAVY DUTY DESIGN—Fully interchangeable with the original Westinghouse roller bearing frame as well as their roller bearing conversion design. However, this design does eliminate interchangeability with the old sleeve bearing armatures.



SPECIAL MEDIUM DUTY DESIGN—Primarily designed to eliminate all frame alterations. When the frame bores are within standard tolerances, the units fit exactly in the space of the old sleeve bearing shell. It provides medium duty capacity, but very satisfactory bearing life. Convenience is the keynote of this design.

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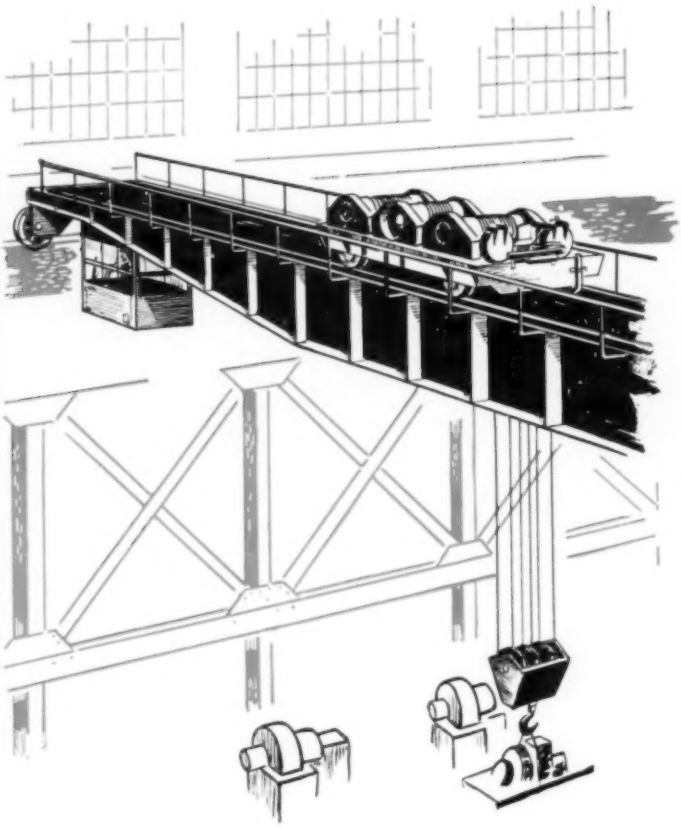
never a bearing failure with Farval



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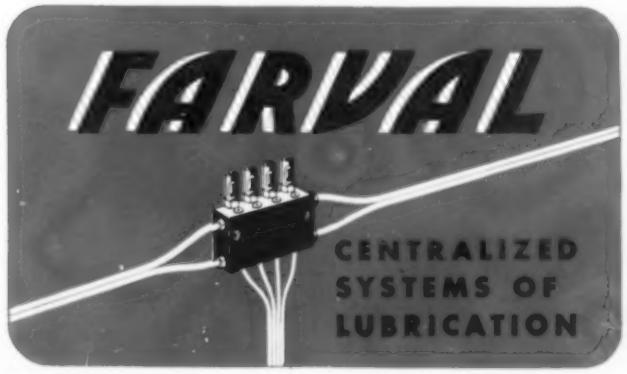

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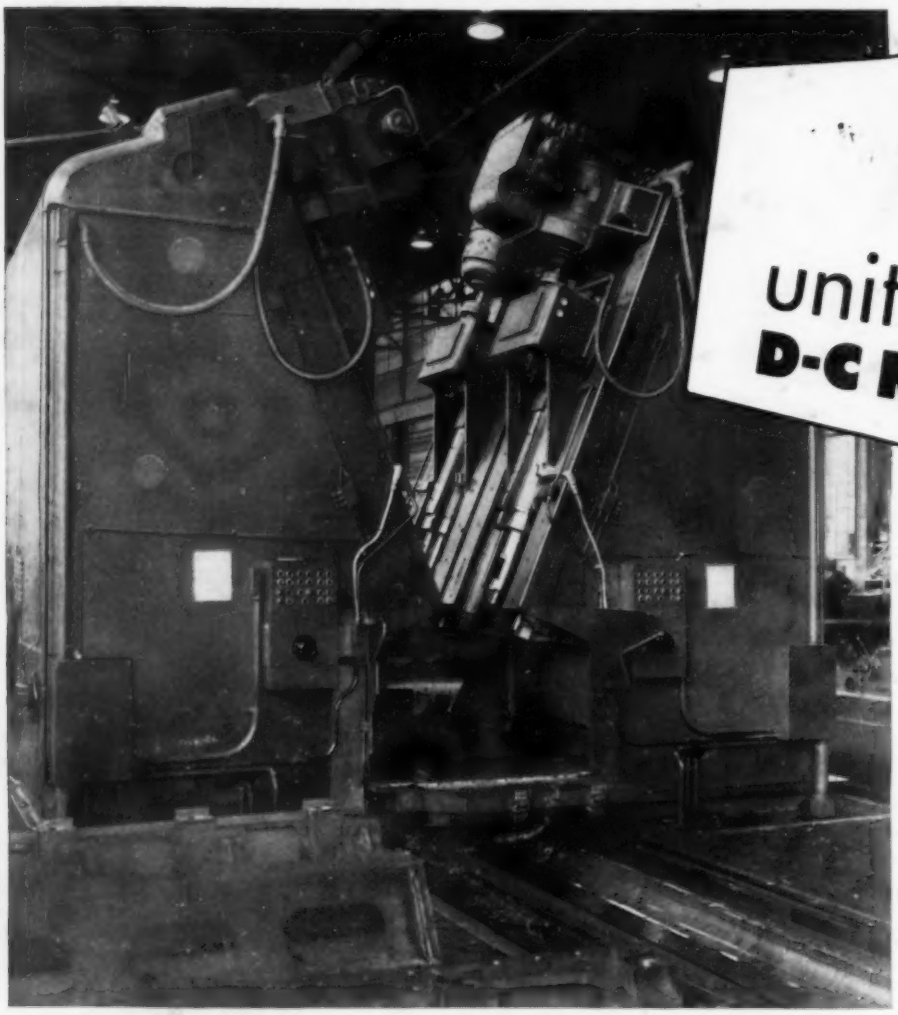

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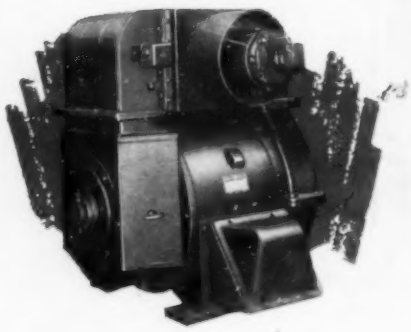
2 types to meet your needs



SINGLE-BLOWER TYPE—
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Here's Protected Power For Harmful Atmospheres . . . Unit-Cooled D-C Motors From 15 to 200 Hp

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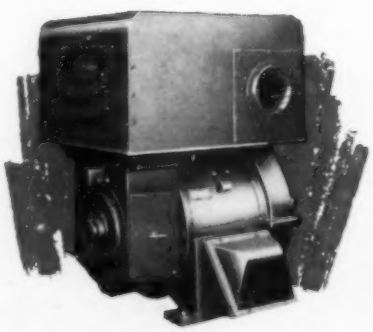
You can buy G-E unit-cooled motors from 15 to 200 hp, for constant or adjustable speed. Ask your G-E representative or write for Bulletin GEA-4469. Apparatus Department, General Electric Company, Schenectady 5, New York.



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